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Dear Reader,

It is my pleasure to extend a warm welcome to readers of the Jefferson Public Citizens (JPC) journal *Public*. This year we have created a new look and feel for our journal to capture the innovation, spirit, and creativity of our JPC students. I am proud to share their experiences, insights and learning with you.

The JPC students began their journey last fall by writing and submitting proposals to conduct research-service projects all around the world. Selected from a competitive pool of applicants, these JPC students worked together to develop their ideas, ask hard questions, and pursue new solutions. Many groups embarked on their projects during the summer while others pursued their work throughout the school year. Students engaged with communities locally, nationally and internationally.

You will find the articles discuss an array of topics ranging from youth mentoring and clean water to saving energy and providing health care. Today’s social issues are profound, vast and unrelenting. It’s an honor for the University of Virginia to offer one of its best resources—passionate, bright, and energetic students—to tackle our world’s most pressing challenges.

I find the JPC students’ accomplishments truly amazing and inspiring, and I have no doubt you will too.

Best,

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Director, Jefferson Public Citizens Program
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Camera Shy or Picture Perfect?

Testing a Picture Tool to Assess Girls’ Peer Relations in the Young Women Leaders Program

By Darby Ford, Morgan Gibson, Katherine Phetxumphou, and Jenna Marshall

Abstract

The stresses resulting from relational aggression and social hierarchy are prominent issues for adolescent girls, with potential negative consequences. The Young Women Leaders Program (YWLP) is a mentoring program that pairs at-risk adolescent girls with college women mentors and addresses issues concerning peer relationships. However, an instrument is needed to effectively assess these relational factors for the girls within YWLP. Our picture tool used peer nominations to assess girls’ perceptions of their peers’ social characteristics. We assessed the usefulness of the tool in evaluating girls’ perceptions of antisocial and prosocial behaviors, as well as the victimization of their group members. We also assessed how these peer nominations were related to perceptions of popularity and being liked. Overall, girls provided more positive than negative nominations of their YWLP peers, which contradicted previous findings on relational aggression. We also found a significant negative correlation between being liked and victimization, and no correlation between popularity and being liked. This confirmed previous findings on the patterns of behavior in popular adolescents. This study lends support to the usefulness of the picture tool in assessing peer relations in adolescent girls without causing immediate social disruptions in the YWLP group.

Introduction

Relational aggression is prevalent among adolescents, especially for girls (Crick & Grotpeter, 1995). Relational aggression is often defined as “intentionally harming another by abusing a relationship” (Remillard & Lamb, 2005, p. 221). Unlike physical aggression, relational aggression is more subtle and may include sarcastic language, hostile attitudes, gossiping, spreading rumors, ignoring, excluding, and staring or making antagonistic facial expressions. Aggressors use such behaviors to target the self-esteem or social status of their victims (Remillard & Lamb, 2005). Apter and Josselon (1998) argued that the higher rates in relational aggression among girls is because girls value their friendships highly with care, trust, and loyalty (Nilan, 1991). When any of these factors are absent, it provides an opportunity for negative tensions between friends to arise (Nilan, 1991). Pubescent girls are especially at risk for relational aggression since they are going through many physical, hormonal, and relational changes, as well as educational transitions. The challenges girls face during this time may contribute to their defiance of traditional social values (Caissy, 1994; Hall, 1916).
Adolescent girls also engage in prosocial behaviors in their interactions with each other. These behaviors are defined as “voluntary actions that are intended to help or benefit another individual or group of individuals” (Eisenberg & Mussen, 1989, p. 3). According to a study done by Asher and Coie (1990), prosocial children are more accepted or well-liked than their peers. Although adolescent girls crave acceptance and reciprocation from their peers, a social hierarchy often exists that can prevent girls from feeling accepted and included. Those with high social status, however, often do not act prosocially (de Bruyn & Cillessen, 2004). Within groups of high-status youth, two types of popular kids can be distinguished: “populistic” kids, who are highly visible, but not necessarily well-liked by their peers, and “prosocial-popular” kids, who are both popular and well-liked. Populistic individuals are also more likely than prosocial-popular children to think deviant behaviors such as bullying and disruptive acts in school are cool (de Bruyn & Cillessen, 2004). Adolescents look up to both of these groups despite the fact that populistic individuals are not well-liked (de Bruyn & Cillessen, 2004).

Populistic individuals may use antisocial behavior like snubbing of lower-status children and rumor spreading to maintain their position in the high-status group (Eder, 1985), which causes their lower-status peers to feel rejected and form negative opinions of the so-called popular kids (Salmivalli & Isaacs, 2005; Eder, 1985). Although these individuals are not liked, they do not tend to be victimized by their peers because their social status serves as a protective factor (de Bruyn, Cillessen, & Wissink, 2009). In contrast to their popular peers, lower-status youth who are regularly victimized may also engage in antisocial behaviors (de Bruyn, Cillessen, & Wissink, 2009).

Contrary to the perceived effects of social hierarchy, which can have negative implications for adolescents, social belonging can emerge as an important protective factor. As children grow older, they look away from their parents and increasingly towards their peers for support, friendship, and influence. Adolescents with a positive sense of group belonging are less likely to have both internalizing (depression, low self-esteem, etc.) and externalizing (bullying other forms of aggressions, etc.) behavior problems (Newman, Lohman, & Newman, 2007). Peer relationships are especially important for girls because their self-esteem is closely linked to their relationships with others (Eder, 1985; Newman et al., 2007). Adolescent girls with healthy peer relationships are less likely to suffer from depression and low self-esteem.

Puberty is a short time frame during which relational intervention groups can be effective in reducing negative social influences and encouraging prosocial interaction (Foot, Chapman & Smith, 1995). The Young Women Leaders Program (YWLP) is an intervention program that pairs at-risk adolescent girls with college women mentors. Sovik-Johnston, Lawrence, Deutsch, & Lee (2010) found that girls who scored lower on measures of relational competence at the beginning of the YWLP program showed greater improvements in their relationships with friends and how they think about themselves after YWLP participation. However, important factors related to adolescent peer relationships, including social hierarchy, social acceptance, and relational aggression, have not yet been assessed in YWLP. An effective procedure or tool for assessing these factors is needed. Such an instrument would allow YWLP to examine its impact, if any, on
girls’ relationships and relational behaviors and make needed program adjustments to address relational issues that may be present among program participants. Another limitation of the current literature regarding the measurement of these relational factors is that the studies have been conducted in the Netherlands with co-ed groups, so they do not generalize to adolescent girls in the United States. Adolescent girls are known to have specific challenges with peer relationships, so it is important that female only relationships are examined.

Current study and hypotheses

The current researchers chose to use a “picture tool” because it is a nonintrusive way to study peer relationships. Using a picture tool interviewing technique, the current study addresses the following questions: (1) Can a picture tool be used with adolescent girls to assess peer relations in a group mentoring setting (YWLP) without creating immediate negative social consequences within the YWLP groups? (2) What kinds of peer nomination patterns emerge when girls assess the peer relations among girls in their YWLP groups? (3) Are there connections between being popular and being liked among early adolescent girls? (3a) What patterns exist in girls’ nominations, if any, between being popular and antisocial behavior, prosocial behavior, and social victimization? (3b) What patterns exist in girls’ nominations, if any, between being liked and antisocial behavior, prosocial behavior, and social victimization? (4) How useful is this picture tool for assessing popularity, being liked, antisocial and prosocial behavior, and social victimization among early adolescent girls?

We hypothesized that: (1) if the mentors and facilitators were sufficiently prepared, the picture tool interview would not cause negative social consequences within the group; (2) given the conflicting viewpoints on relational aggression and prosocial behavior in adolescent girls, there would be an equal amount of positive and negative nominations as well as a significant positive correlation between relationally aggressive behaviors and peer victimization; (3) there would be no correlation between being popular and being liked; (3a) popularity would negatively correlate with being victimized, but would not correlate with either relationally aggressive or prosocial behavior; (3b) being liked would be negatively associated with antisocial behavior and victimization, and would be positively associated with prosocial behaviors; and, (4) that the picture tool would be useful in assessing the five evaluated factors of peer relationships (antisocial behavior, prosocial behavior, victimization, popularity, and being liked). We constructed these five factors based on our review of the literature, compiling factors that have been studied and identified as important across studies. We then examined the items in the photo tool to determine how they mapped onto concepts identified in the literature.

Method

This study was conducted using a sample of girls from YWLP, a mentoring program that pairs adolescent girls with college women mentors. School guidance counselors nominate girls who are at risk for making poor academic, social or behavioral decisions but who also have leadership
potential. The program consists of one-on-one mentoring in addition to weekly group meetings with seven to ten mentor-mentee pairs and a facilitator. Groups follow a standardized curriculum, with activities associated with weekly themes. For example, for the “Keeping Our Cool” week, the groups review strategies for thinking independently and staying calm in stressful situations. Other themes include avoiding gossip, appreciating others, honoring differences, and expressing ourselves in a non-confrontational manner.

We had concerns that our study could provide an unintended opportunity for girls to think about their peers negatively and to gossip with each other about who they had nominated for various items. To reduce this possibility, we piloted the study with a sub-sample of eight girls from YWLP in order to assess the immediate consequences. All girls’ parents had previously provided informed consent, and the girls provided informed assent on the day of the procedure. We interviewed this sample of girls on a day when their group was having an event outside of their regular school setting. We hoped that this setting would help separate any incidents that arose from the interview from their typical group routine.

After conducting the interviews using the photo tool, we consulted with the big sisters in the group and found that no immediate social disruptions occurred within the group after our interview procedure. This confirmed our first hypothesis that, with adequate preparation, there would not be noticeable disruptions in group. After two weeks of discussion, we decided to continue with our study and use the tool with the remaining sample.

Sample

Our sample included thirty-one 7th grade girls in YWLP ranging in age from 11 to 13 years old. These girls comprised four mentoring groups, each from a different middle school in Central Virginia. We did not include the fifth YWLP group because these middle school girls had recent incidents of antisocial behavior and we were concerned that our interview could lead to further disruption.

Procedure

The study was conducted to assess a picture tool designed to evaluate peer nominations of prosocial and antisocial behavior. All girls’ parents provided informed consent at the beginning of the program as part of the ongoing YWLP study approved by the University of Virginia’s Institutional Review Board. After our pilot procedure, we conducted the remaining interviews during the mentoring group times.

Mentoring groups began meeting together in September 2010. Between November and December, we met the groups at their regular meeting locations to conduct our study. Each participant was taken away from the group to a quiet, confidential location to be interviewed by one or two members of the research team. Each girl was assigned a code number, which was put at the top of her record sheet. The document connecting girls’ names to code numbers was kept separately in a locked file cabinet. After each girl provided informed assent, the researcher explained that
she would be asking a series of questions regarding others’ behavior and that the girl should nominate other members of her group and/or herself as they pertained to each question. Each subject was told that she could nominate as many or as few girls as were appropriate for each question. She was asked to point to the picture(s) of the girl(s) she wished to nominate on a corkboard that contained pictures of all the girls in her mentoring group. After answering all eighteen questions, the interviewee was thanked and given a small gift for participating in the study. In order to buffer any negative effects of nominating their peers, each girl wrote one positive comment about each of the other girls in her group on a paper plate that was later distributed to all the girls in the group.

**Measure: The Picture Tool**

The picture tool consisted of two parts: a corkboard for each mentoring group with individual pictures of each girl, and a list of eighteen questions for which each subject was asked to nominate girls from her group who fit the descriptions. The questions assessed the girls’ perceptions of three categories of social behavior: antisocial (negative active - NA), prosocial (positive active - PA), and victimization (negative passive - NP), as well as popularity and being liked. These categories are associated with social hierarchy and relational aggression in adolescence. There were seven items evaluating perceptions of antisocial behavior, which included “Who teases, bosses, or threatens other kids a lot?” and “Who tries to exclude other kids?” Three items assessing prosocial behavior included “Who gets along with others and cooperates a lot” and “Who talks in a friendly way to other kids a lot?” Four items assessed victimization, including “Who gets excluded by other kids?” and “Who do other kids say mean things about when she is not around?” There was one question assessing popularity: “Who is popular at your school?” and another evaluating which girls were liked: “Who do you really like?”

**Results**

On average, there were more positive (M = 15.34, SD = 2.99; means represent the average number of girls nominated per item) than negative (M = 5.90, SD = 5.68) nominations. This was true for each of the four mentoring groups individually as well as for the sample as a whole. We then calculated the cross-correlations for the five different social factors. Positive (PA) and negative (NA + NP) nominations were not significantly correlated (r = -0.279, p = 0.136). In addition, NP nominations were not significantly correlated with PA or NA nominations.

The questions “Who do you really like?” and “Who is popular at your school?” were not significantly correlated (r = .038, p = .838), indicating that in our sample, being popular was not significantly associated with being liked by the girls in their mentoring group. The cross-correlations between popularity, being liked, and negative-active and negative-passive nominations indicated that the only significant association was between being liked and negative-passive characteristics, which were negatively correlated (r = -.421, p = .018). The correlation between popularity and negative-passive approached significance (r = -.326, p = .074). Negative-active and negative-passive nominations were not correlated (r = .032, p = .866) [See Table 1].
TABLE 1. Intercorrelations between relational factors

<table>
<thead>
<tr>
<th></th>
<th>Popular</th>
<th>Really like</th>
<th>Positive Active</th>
<th>Negative Active</th>
<th>Negative Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Popular</td>
<td>----</td>
<td>.038</td>
<td>-.169</td>
<td>.183</td>
<td>-.326^</td>
</tr>
<tr>
<td>Really like</td>
<td>.038</td>
<td>----</td>
<td>.170</td>
<td>-.070</td>
<td>-.421*</td>
</tr>
<tr>
<td>Positive Active</td>
<td>-.169</td>
<td>.170</td>
<td>----</td>
<td>-.279</td>
<td>.221</td>
</tr>
<tr>
<td>Negative Active</td>
<td>.183</td>
<td>-.070</td>
<td>-.279</td>
<td>----</td>
<td>.032</td>
</tr>
<tr>
<td>Negative Passive</td>
<td>-.326^</td>
<td>-.421*</td>
<td>.221</td>
<td>.032</td>
<td>----</td>
</tr>
</tbody>
</table>

* p < .05  
^ p < .10

Discussion

Overall, there were more positive than negative nominations, indicating that the girls in our sample were more willing to say positive things about others within their group. This contradicts our second hypothesis that there would be equal negative and positive nominations, and it seems contrary to the abundance of findings on the prevalence of relational aggression in adolescents, especially between girls. It is important to keep in mind, however, that their responses may not have been a true reflection of how they feel. Eder (1985) contended that girls, in particular, are likely to minimize their differences from other girls in their social group in order to gain acceptance. Therefore, the girls’ tendency to provide mostly positive nominations suggests that they may have been trying to fit in with their group.

Another possibility is that they were trying to protect the members of their group by not sharing negative information about each other to the researcher: an “outsider.” The girls may have felt as though the researcher would judge them if they said negative things about girls in their group, so they opted to report mostly positive characteristics instead. Such “social desirability” can be a threat to validity for research instruments. Perhaps a more impersonal form of data collection would result in more accurate responding, such as an online or paper survey that is completed independently.

On the other hand, the girls’ positive nominations may be a true reflection of how they feel about one another. A study on an intervention technique called Positive Peer Reporting (PPR) found that encouraging adolescents to say positive things about each other was effective in enhancing peer interactions. When adolescents praise positive behaviors in their peers, it can change their perceptions of those who may have been socially rejected or neglected (Morrison & Jones, 2006). As the girls nominated their peers for more positive behaviors, they utilized PPR tech-
niques in order to shine a positive light on their group, their peers, and as a result, themselves. Given that YWLP encourages positive interactions between group members, it is possible that our findings reflect girls’ learned tendency to say positive things about each other in order to portray themselves and their group positively.

On average, there were more negative-passive than negative-active nominations. For example, the girls were more willing to say who is getting teased rather than who is doing the teasing. Perhaps they did not want to bring attention upon themselves by singling out aggressors in their groups. Again, they may have been protecting themselves or their peers by simply not “tattling” on the aggressor. A study evaluating tattling patterns in youth found that those who tattled on their peers were generally less liked, and were more socially rejected than their peers who did not tattle (Friman et al., 2004). The adolescent girls in our sample may have refrained from tattling or going against any of their peers in order to avoid being disliked. Contrary to our expectation, the correlation between negative-active and negative-passive nominations was not significant, indicating that those who were perceived as being victimized were not relational aggressors and vice-versa. One possible reason is that of those who engage in negative-active behaviors, some are bully-victims and others are populistic individuals (de Bruyn et al., 2009). Because aggressive behavior is distributed among individuals of both high and low social status, it follows that negative-active characteristics would not directly correlate with victimization, a characteristic of low social status.

Similar to the finding by de Bruyn et al. (2009), which indicated that popularity is not necessarily associated with being liked, our analyses found no significant correlation between being popular and being liked, confirming our hypothesis. This strengthens the contention that being liked is not a necessary condition for being perceived as popular. Positive-active and negative-active characteristics were not associated with popularity, which supported our hypothesis. One explanation is related to the two types of popular individuals: prosocial-popular and populistic (de Bruyn & Cillessen, 2004). This suggests that there may be a third variable, acceptance or liking, that moderates the association between popularity and antisocial behavior (de Bruyn et al., 2009). Future research using the picture tool could assess this additional hypothesis. Another possible reason why we did not find negative-active characteristics to be correlated with popularity is that these behaviors are located at both ends of the popularity spectrum, meaning that both high and low status adolescents engage in relational aggression. This creates a positive curvilinear association (de Bruyn et al., 2009), which cannot be indicated with a correlational analysis.

The negative association between negative-passive characteristics (such as being excluded or threatened) and popularity approached statistical significance. Since our hypothesis predicted a significant negative correlation between these factors, our findings did not completely support this expectation, but approached confirmation. This trend suggests that individuals who were victimized tended to be unpopular. This indicates that neither populistic nor prosocial popular individuals are victimized, supporting previous findings that popular girls are associated with active (antisocial or prosocial) characteristics and are respected as influential, even if they are
not liked. They are more likely to be the ones doing the teasing and excluding to maintain their social position, rather than being the victim of these actions (de Bruyn & Cillessen, 2004). Further research needs to be done to explain how different popular individuals maintain their social position and prevent themselves from being bullied.

It was expected that being liked would positively correlate with positive-active characteristics and negatively correlate with negative-active characteristics. Contrary to expectation, neither positive-active nor negative-active characteristics significantly correlated with being liked. There are several possible explanations for this finding, one of which could be variations in personal preferences (i.e., girls only picked their best friends). Another possible explanation is that the girls could have conflated their interpretation of popularity and liking, such that they still nominated some of the more popular girls with negative-active characteristics because they are still considered desirable, visible, and leaders among their peers (de Bruyn & Cillessen, 2004).

We hypothesized that negative-passive characteristics would show significant negative correlation with being liked, which was confirmed. A limitation with this finding is that the questions assessing negative-passive characteristics assess how much each girl is being victimized, but our tool does not tell us why they are being victimized. Girls may not have reported “really liking” a girl who is typically victimized so as not to be associated with someone of lower social status. It is also possible that these girls are not liked and are victimized because they deviate from the social norm of the group. Future research should focus on which girls are excluded and the impact of being excluded on peer relationships.

Our final hypothesis was that the picture tool would be useful in assessing five characteristics of adolescent peer relations (e.g., popularity, being liked, antisocial behavior, prosocial behavior, and victimization). Overall, we found that the tool was effective at distinguishing between these behaviors and social hierarchy factors without causing negative social consequences within groups of adolescent girls. This is an encouraging finding, confirming the picture tool could be an effective method for assessing peer relations in adolescents. Our findings also confirmed that popularity and being liked are not necessarily related and tend towards being negatively correlated with victimization, further reinforcing previous findings that being liked or being popular protects against being victimized (de Bruyn & Cillessen, 2004).

Overall, our tool could be useful in assessing different domains of interpersonal relations among adolescent girls. However, we found items 10 and 11 to be less useful (e.g., “Who hits or pushes other kids a lot?” and “Who gets hit or pushed a lot by other kids?”). For these items, fewer than 5 girls out of the sample of 31 were nominated once, and no one was nominated more than once. For future use of this tool with similar populations, these items could be excluded from the interview. Findings from the pilot project indicate that the tool can be used to assess relational factors in programs such as YWLP without causing immediate social disruption. However, since all groups are different, it is also important that future researchers pilot the project to account for potential consequences.

Additionally, the high ratio of positive to negative nominations that we found suggests that proactive behavior may be more common in adolescent girls than what is perceived, and it
represents an area of social interaction that deserves more attention. It is also an encouraging finding since it is possible that YWLP supports positive interactions among its members. This is something that should be continually emphasized in the curriculum. While relational aggression is still an important issue during adolescence, positive interactions are also prevalent among adolescent girls. Research examining this phenomenon in more depth could be useful for informing intervention programs not only on how to reduce negative interactions but how to encourage positive ones.

Another applicable finding is that being liked and being victimized are negatively correlated. While there were relatively few nominations for girls being victimized, it is still present within the YWLP groups, and is an issue that should be taken into more consideration in curriculum modifications. This can be established within YWLP groups by emphasizing a sense of belonging and encouraging prosocial behavior among the little sisters outside of group meetings.

However, there are several limitations to our findings. The first is that our tool assesses adolescents’ perceptions of peer relational behaviors, not actual behaviors. Thus, the nominations may not accurately reflect the actual behaviors of the girls nominated. Secondly, each of the subjects was nested within a mentoring group, each of which was nested in a different school. Given differences between YWLP groups, such as socioeconomic status, racial breakdown, and school culture, this could have confounded our results. Similarly, we collected our data at the end of the first semester, when the groups had already been meeting together for about nine weeks. By that point, membership in YWLP may have created a sense of group connectedness, and the social bonds among the girls may have influenced what they were willing to report about each other.

Further, YWLP provides a unique environment that encourages positive interactions among group members. McLoughlin (2009) contended that when young people feel as though they have a voice in their schools and communities, they make decisions to act positively. While this is an encouraging finding, it supports the possibility that girls in YWLP nominate their YWLP peers positively because of the positive influence of the program. Thus, it may be more useful to conduct the picture tool assessment before the groups are formed, or among peer groups that are not in a structured intervention program aimed toward positive peer interactions. This would also increase the generalizability of the findings. Another factor influencing the generalizability of our findings is that the girls in YWLP represent an at-risk group of adolescents, and thus our results may not also apply to non-at-risk youth.

Future research should address these limitations and should also examine the usefulness of this tool in assessing change with a pre-post research design, which would address changes made over the period of the intervention program. Additionally, peer nominations on the picture tool were categorical; they were either nominated or were not nominated for each item. Further research could also be done using the same questions, but on a Likert scale such that the researchers could determine which girls were least/most popular or liked and determine what characteristics are correlated with each of these variables. Future research could assess nomination patterns for girls of different social status (i.e., to assess whether popular girls tend to make different nominations compared to victimized girls).
References


Biographies

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The Grand-Aides Program in Baotou, Inner Mongolia

By Christiana White, Mary Van Meter, Alex Eschenroeder, Lily Bowles, Gordon Carver, Michael Marquardt, and Forrest Compton

Abstract

The Grand-Aides Program involves training community elders to treat minor health problems within their community, in order to provide less expensive and more accessible health care to regions of modest economic status. By providing another outlet of health care, the program also aims to alleviate unnecessary crowding in hospitals and community clinics. University of Virginia students traveled to the Inner Mongolia region of China to collect baseline data on patient visits in hospitals and clinics in order to determine the potential effectiveness of a future Grand-Aides program. The collected data suggested that 53% of all clinic and hospital cases observed in the study could have been cared for by a Grand-Aide, with children’s visits showing an even higher percentage of symptoms treatable by a Grand-Aide. These results suggest that once successfully implemented, the Grand-Aides program would have a significant impact on the Inner Mongolian health care system.

Introduction

Many people in Inner Mongolia live within walking distance of health care clinics; however, these clinics often have long waits and inconsistent care. As a result, these people may opt to remain untreated in an effort to avoid long lines and poor service. The only other option available to the large, relatively poor population in this area is the emergency department, so they rarely receive quality health care, especially for chronic diseases. Emergency care is meant to stabilize patients in emergency situations, not provide ongoing care for chronic disease. Grand-Aides seeks to circumvent this problem by providing an intermediary source of medical attention in the form of trained grandparents. We expect Grand-Aides will increase patient welfare, reduce overall hospital expenses, utilize resources more efficiently, take advantage of an eager pool of labor and galvanize change that will further improve health care and increase both standards of living and life expectancy.

Grand-Aides was founded in 2008 with the idea that an experienced grandparent can successfully treat many of the medical cases presented in hospitals and health clinics worldwide. Since the formal establishment of Grand-Aides, pilot programs have been initiated domestically in cities such as Houston, Texas and Harrisonburg, Virginia and internationally in cities such as Shanghai and Baotou, Inner Mongolia. While it is still too early to accurately gauge the success of these programs, continued interest from world leaders such as the Prime Minister of Bangladesh indicate a strong global belief in the benefits that Grand-Aides has to offer.
Regardless of the location of the program, every Grand-Aide must have at least a high school education and successfully complete Grand-Aide training. The training program is customized to each program location, but usually it is divided into two-month sections punctuated by testing. Training of the primary care Grand-Aides begins in the classroom, where trainees learn about basic medical care techniques, the appropriate use of technology and primary care protocol. Next, they enter a period of additional classroom training with a specific focus on fieldwork procedures followed by a period of supervised fieldwork, during which they begin to meet their patients and work according to their newly learned protocols. Finally the Grand-Aides enter a period of primary care fieldwork with an assessment every six months (Grand-Aides Training Flow Chart, 2010).

Once practicing, Grand-Aides care for 200 to 250 families as paid professionals. They will either make home visits or give advice over the telephone if a family member complains of symptoms. Health professionals such as nurses and physicians’ assistants supervise the Grand-Aides during these calls and visits (the supervisor is on the phone and available whenever the Grand-Aides are working), ensuring quality while also allowing greater individual patient attention. Patients will still have access to physicians if needed, but this added level of primary attention will increase access to care so that symptoms do not remain untreated due to lack of access to care. In an effort to promote healthy behavior, Grand-Aides will also make home visits to teach preventative care and early management of primary care conditions (Grand-Aides, 2010).

Since Grand-Aides is a new program, without any published studies yet, it must be assessed and practical methods for implementation must be developed to determine the actual need for Grand-Aides in each area. With this in mind, the research team traveled to Baotou, Inner Mongolia to assess the need for Grand-Aides and help develop the methodology for the future assessment of the program’s success.

The research goal was to determine the potential demand for Grand-Aides in a specific neighborhood in Baotou that is served by the Fourth Affiliated Hospital of the Inner Mongolia Medical College (IMMC). This community has three forms of health providers: the hospital clinic, a local community clinic and an emergency department. In order to determine the demand, the research team reviewed medical records dated from January 1, 2009 to December 31, 2009 and answered the question – What percentage of patients that visited these three venues could have been cared for by a Grand-Aide? Through analysis of the data in these medical records with methods explained below, the team numerically gauged the local need for Grand-Aides by determining what percentage of the population that visited the three venues could have been cared for by Grand-
This data will also be used as a baseline for future studies on the success of the Grand-Aides program in Baotou.

**Methods**

Data collection involved compiling all available medical records from the emergency department, hospital clinics and community clinics in a specific neighborhood in Baotou. In total, 50 medical record books were utilized for the study, containing 35,148 individual patient visit entries. With a full calendar year of data, the research team was confident that the collected data was representative of the health care utilization trends of the Baotou community because any seasonal trends could be recognized and accounted for in the results. With a large and random sample, the data could be used to determine the future demand for Grand-Aides in the area.

The data collection and translation process involved pairing IMMC students with UVA students to translate medical records and record the relevant patient data in English. The following data variables were collected: patient visit location, date, sex, age and diagnosis. The patient diagnosis was reported by clinical condition name if the patient had one of the 28 common conditions that could be potentially cared for by a Grand-Aide, as listed in Table 1. If the patient did not have one of the 28 common conditions, then “not applicable” was recorded in the patient visit entry. A patient entry was completely omitted if any part of the entry was illegible, as determined by the IMMC student. The project received a waiver from the Institutional Review Board of the University of Virginia.

Data were collected and analyzed using Microsoft Excel. The research question was analyzed by calculating the count and percentage of pediatric and adult cases at the community clinic, hospital clinic and emergency department that Grand-Aides could have potentially cared for. In determining the percentages of patient visits that could have been treated by Grand-Aides, we assumed that Grand-Aides could care for all patients affected by the 28 common conditions (See Table 1). The resulting analysis determined the percentage of patients with one of the 28 common conditions divided by the total number of patient visits collected from each of the three health care provider locations.

**Table 1:**

<table>
<thead>
<tr>
<th>Common Cold</th>
<th>Nausea, Vomiting, Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestion</td>
<td>Nausea, Vomiting, Child</td>
</tr>
<tr>
<td>Cough</td>
<td>Abrasion</td>
</tr>
<tr>
<td>Earache, Drainage</td>
<td>Insect Bite</td>
</tr>
<tr>
<td>Headache</td>
<td>Rash, Adult</td>
</tr>
<tr>
<td>Sore Throat</td>
<td>Rash, Child</td>
</tr>
<tr>
<td>Abdominal Pain, Adult</td>
<td>Back Pain</td>
</tr>
<tr>
<td>Abdominal Pain, Child</td>
<td>Joint Pain, Swelling</td>
</tr>
<tr>
<td>Constipation</td>
<td>Breastfeeding Problems</td>
</tr>
</tbody>
</table>
Results & Outcomes

A total number of 35,148 patient visits were observed at three different locations: a community clinic, hospital clinic, and hospital emergency department. Results are summarized in Figure 1 below.

**Figure 1:**
Total Percentage of Patient Visits Potentially Cared for by a Grand-Aide

<table>
<thead>
<tr>
<th>All</th>
<th>Child</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Percentage</td>
<td>53% (n=18,625)</td>
<td>74% (n=5076)</td>
</tr>
</tbody>
</table>

In total, 18,625 patients were diagnosed with 1 of the 28 common conditions potentially cared for by a Grand-Aide. This means that roughly 53% of the annual patient visits at these locations could have been cared for by a Grand-Aide. About 74% of pediatric patients and 48% of adult patients could have been cared for by a Grand-Aide. A breakdown of the results by location is shown in Figure 2.

**Figure 2:**
Total Percentage of Patient Visits Potentially Cared for By a Grand-Aide at Each Location

<table>
<thead>
<tr>
<th>Location</th>
<th>All</th>
<th>Child</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Clinic</td>
<td>64% (n=7593)</td>
<td>87% (n=6648)</td>
<td>62% (n=945)</td>
</tr>
<tr>
<td>Hospital Clinics</td>
<td>46% (n=7007)</td>
<td>75% (n=3860)</td>
<td>32% (n=3147)</td>
</tr>
<tr>
<td>Hospital ED</td>
<td>49% (n=4025)</td>
<td>47% (n=271)</td>
<td>49% (n=3754)</td>
</tr>
</tbody>
</table>

At 64%, the community clinic had the highest percentage of patients diagnosed with 1 of the 28 common conditions. The community clinic had the highest percentage of pediatric
patients potentially cared for by a Grand-Aide at 87%. They also had the highest number of adult patients with 1 of the 28 common conditions at 62%.

In the hospital clinics, 46% of the patients were diagnosed with 1 of the 28 common conditions. As in the community clinic, categorizing patients by age within the hospital clinics showed a significant variation between pediatric and adult patients: 75% of pediatric patients and 32% of adult patients had symptoms treatable by a Grand-Aide.

Similar to the hospital clinics, 49% of the patients visiting the hospital ED were diagnosed with 1 of the 28 common conditions. Variation by patient age was minimal, with 47% of pediatric and 49% of adult patients potentially cared for by a Grand-Aide.

**Discussion**

The goal of this project was to determine the need for Grand-Aides in Baotou, Inner Mongolia. The results of the study showed that almost half of adults and nearly three quarters of children went into a clinic or emergency department for symptoms that could be treated by a Grand-Aide with basic health care training. Therefore, a program like Grand-Aides could significantly improve the quality of and access to health care in this region.

Introducing Grand-Aides would improve this community’s health care system in several ways. First, it would increase access to health care – another level of care would be freely available to all patients. Rather than having to miss work and wait in line at a clinic or emergency room, patients would be able to call a Grand-Aide and receive the care they need right away. The Grand-Aides program could also greatly improve the quality of care patients receive. Grand-Aides would have more time to spend with patients than doctors, so they could form closer patient-caregiver relationships, be able to make house calls and keep their patients on track through treatment plans. This level of care could greatly improve the quality of available health care in general. The high percentage of cases that could be treated by a Grand-Aide means that this program could have a profound impact by decreasing the overcrowding and waiting time in clinics and hospitals and allowing doctors to focus more on the patients who really need a higher level of training in order to be treated.
The results of this experiment suggest an overwhelming need for Grand-Aides in Baotou; however, there were some noteworthy limitations on the data used. In order to perform this research, researchers collected all of the hand-written ledger books for a full calendar year from the three desired locations. The entire year was used in order to have a statistically significant number of records in each location and to be sure that the data would not be affected by the inherent seasonality of certain illnesses (for example, more people are likely to get the flu during flu season). The data were not complete, however, because some ledger books had been lost over the year and others were written such that they were illegible to the Chinese students who were translating them (see picture). Although some of the data were missing, the results were still statistically significant because the data that were missing were determined to be random (from different time periods and clinics) and there was still a large enough data set.

Another problem with our data was that it was all written in Chinese, so it had to be translated before it could be recorded into Excel. There may have been translational errors that occurred, but each translator learned English at the same school and was given the same training as to how to complete this study, so any errors that did occur should have occurred consistently throughout the process. There was ongoing dialogue between the translating students and the research team, so the likelihood of translational error is minimal.

Finally, health care records in China, and especially in the clinics visited in this study, were not as consistent or thorough as those in the United States. Often, patients would have a single symptom listed, “headache” for example, and there would be no further information. Since “headache” is one of the conditions that Grand-Aides will be trained to treat, this would be listed as a patient that could have been cared for by a Grand-Aide. However, this patient could have had additional, more complex symptoms or diseases that were simply not recorded. Because of the potential incompleteness of these records, the
percentages found in this study could be higher than the actual percentages of patients that could be cared for by a Grand-Aide. This problem, however, does not have strong implications toward the implementation of Grand-Aides in Baotou – even decreasing the number of patients who go to the clinics by 10% would greatly improve health care quality and access.

The results from this study show that the Grand-Aides program would not only succeed in Baotou, but is needed. The health of this population suffers from overcrowding and long wait times in clinics and hospitals. This study shows that a high percentage of the patients in these clinics and hospitals could be taken care of by a Grand-Aide instead. In addition to helping solve overcrowding problems, Grand-Aides will be able to provide higher quality primary care by spending more time with patients and providing more personal, individualized care. Six Grand-Aides began training in the summer of 2010 in Baotou and will start seeing patients by 2011. The results from this study will be used as a baseline to compare with later data on hospital and clinic visit numbers and symptoms as Grand-Aides are introduced into their health care system. Hopefully, Grand-Aides will generate results within the community showing increases in access to and quality of health care, decreased costs and improved overall health of the population.

References


Biographies

**Christiana White** is a third year student from Vail, Colorado completing an Interdisciplinary Major in science, public policy, economics and ethics to study the American health care system. She has been on the team to develop Grand-Aides since her first year and is also an Honor Council member and President of Kappa Kappa Gamma.

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Automated Drapes

Reducing Home Energy Consumption

By Matthew Jungclaus, Christopher Greenwood, and Molly Tyeryar

Abstract

An interdisciplinary team from the University of Virginia engaged in the design and implementation of an energy-reducing automated drape system. The final system is to be used as an educational tool in the Local Energy Alliance Program’s showcase for energy efficiency in Charlottesville, VA.

Introduction

Over 25% of United States residents make less than $25,000 per year, yet energy costs for a typical single family home are, on average, $2,200 annually (Energy Star, 2009; U.S. Census Bureau, 2007). High energy usage leaves these homeowners with expensive bills and leads to increased consumption of environmentally harmful fossil fuels. Many low-income homeowners are caught in an endless cycle of paying expensive energy bills without the resources to find a more affordable alternative. Additionally, homeowners across socioeconomic boundaries are becoming more aware of America’s dependence on fossil fuels for energy generation. Homeowners in both of these categories seek sustainable methods of reducing energy consumption in order to decrease costs and environmental impact.

The Local Energy Alliance Program (LEAP), a Charlottesville nonprofit advocate for home energy efficiency, and ecoMOD, a University initiative for affordable, sustainable housing, have teamed up to create a venue for local energy efficiency education. The ecoREMOD project is a full home-energy remodeling project and the result of this collaboration. The house will serve as both LEAP’s headquarters and a showcase of energy efficiency in the community. Displays will educate homeowners about methods of improving home performance and about LEAP’s programs. A second Jefferson Public Citizens team has been awarded a grant to develop educational materials and displays for ecoREMOD and details the overall ecoREMOD project more specifically.

The following report will outline this team’s efforts to design and build an automated drape system that acts as both a working demonstration of energy efficiency and as an educational display for the ecoREMOD house.

Project Background

Windows are one of the most inefficient components of a residential building and account for a
great deal of energy loss. They accept approximately twenty times more heat flow than an average wall section (Radiant Barriers) and will put a strain on a home’s heating, ventilation, and air conditioning (HVAC) systems during months of heavy heating and cooling. Despite these inefficiencies, windows provide ambient light and fresh air, two important criteria for home comfort. The team recognizes that windows are an essential component of any hospitable living space and look to effectively control the aforementioned heat flow.

The team decided to achieve passive energy savings by designing an automated drape system for one of the windows in ecoREMOD. The proposed system would measure the solar radiation entering the window and indoor/outdoor temperature readings, all of which affect heat transfer through the window. These measurements would then be used to determine whether it would be more energy efficient to have a set of insulated drapes open or closed.

In order to have a marketable public impact, this control system would need to be easy to install in existing homes and simple enough that the average homeowner could use the system. Some might compare the aim of this system to that of a programmable thermostat. In the past, all homeowners were expected to manually change their thermostat if they wanted to save energy by reducing heating and cooling at night or while at work. Now, homeowners have the option of using automated thermostats, which allow them to set a schedule that will automatically run their HVAC system when desired, often resulting in reduced energy usage. Similarly, the team designed an automated drape system that would cause an insulated drape to raise and lower in order to minimize HVAC usage year-round. The main difference in the system design is that homeowners would not even need to program this system, as it is a fully functional mechatronic system. However, the homeowner’s need to control the drape was also recognized, so the homeowner may use an override button to let light in or close the drapes for privacy without interruption from the system.

**Methodology**

The automated drape system was designed in two phases. In the first phase, the team designed a logical algorithm for the system, which explored how variables such as interior and exterior temperature, light readings, and time of day interact with each other to affect HVAC usage. The team also determined the optimal placement for the system in ecoREMOD. Since there will only be one drape display in the home, the ideal window would be in a central location and receive a good deal of sunlight during the day. More sunlight would maximize the efficiency of the drape system and would result in a more frequent demonstration of opening and closing. The central location of the drape simply serves the purpose of being easily accessible to visitors.

The second phase of design dealt with the technological aspect of the system. After determining which data to collect, a hardware and software system had to be designed to implement the system. This system would need to obtain environmental data through a sensor network, perform the heat flow analysis, and communicate with a motor to open or close the blinds accordingly. The team further explored the design of these two facets of the project independently.
Heat Flow Analysis

Heat flow (and resultant energy loss) through and around a window can be broken down into four basic classifications. When sun is shining through the window, solar radiation is transmitted through the glass and causes a flow of heat from the exterior of the house inward. Additionally, conduction, a process in which heat flows across a thermal medium, occurs through the window surface. This results in heat being lost to the outside during colder months and heat leaking in from the outside during warmer times of the year. Convection occurs across either side of the window surface, and deals with heat transfer through a fluid (air in this case). Convection essentially delivers the heat loss or heat gain through a window to the rest of the house. Another notable method of heat flow is air infiltration. This should not be an issue in the ecoREMOD house, which will have brand new windows. However, older homes with leaky window frames may experience varying levels of infiltration that depend on window quality, wind patterns, and temperature differentials across the window.

The goal of the system is to compare the heat flow through an open drape (caused by radiation and conduction) to heat flow through a closed drape (only due to conduction). When the temperature outside is much greater than the indoor temperature (summer months), the system aims to minimize the amount of heat flowing into the house, thus aiding the cooling process. When the outside temperature is much colder than the inside (winter months), the system aims to minimize outflow of heat. This results in closing the blinds unless solar radiation overcomes the temperature gradient and aids the heating process.

The above analysis can be quantified using several fundamental equations to describe the net heat flow in any given situation. The heat flow due to solar radiation can be calculated using the following equation:

\[ \text{Heat}_{in} = \text{Light intensity} \times \text{Area of window} \]

Light intensity values are obtained from the sensor, which outputs a voltage value directly related to light intensity in illuminance. This value can be translated into an estimation of light intensity by scaling by the constant of luminous efficacy (for sunlight, this constant is 80 lumens/Watt).

The heat transfer due to conduction is governed by the following equation, which relates tem-
perature gradient and the R-value (a measure of thermal resistance) of a medium to heat flow through that medium:

\[ Heat_{in} = \frac{1}{R} \times \text{Area of window} \times (T_{out} - T_{in}) \]

The above calculated heat flows can be positive or negative depending on whether the temperature is warmer inside or outside the building.

When two layers exist between temperature gradients, such as this window and drape, the R-values add together to give a combined R-value. Typically, one could expect a window to have an R-value between one and two, with the most efficient (and expensive) models reaching R-3 or R-4. This value depends on special coatings, treatments, the number of windowpanes, and the type of window framing. Theoretically, the proposed drape would more than triple the R-value of the window (R-2 window with an R-5 drape would be equivalent to R-7). The system is set to minimize heat flow through the window.

Heat flow due to convection and infiltration is noted above, but does not need to be an active part of calculation. Convection is simply a form of heat flow that delivers conducted and radiated heat to the rest of the house. Though infiltration may have an effect on window performance, the design of the drape system aims to reduce the negative effects of air infiltration.

Using heat flow approximations, the system can compute total heat flow under two separate conditions – open and closed. Once these two values are calculated, the system uses the temperature gradient to infer whether heating or cooling is taking place, and chooses to open or close the drape in order to aid the HVAC system accordingly.

**Physical System Design**

Once algorithm design was complete, the team had to design the physical components of the system. This involved choosing the drape itself, designing the hardware components to take measurements from the environment, and interfacing those sensors with a software system that would make the necessary calculations to determine the proper orientation of the blinds.

When selecting a drape for the system, the aim was to choose one that would turn the window into an effective thermal barrier between the indoor and outdoor environments when closed – an attribute quantified by the R-value of the drape. In doing so, the team maximized the effect that closing and opening the drape had on conductive heat transfer through the window. The team chose cellular blinds, which are comprised of vertically stacked air pockets separated by accordion-style material. When the air pockets are isolated, they act as an additional layer of insulation between the layers of fabric.

One possibility in mounting the blinds was to use a tracked system, which would bind the blinds to the window frame on all sides and keep air infiltration to a minimum. Though ecoREMOD will provide new windows with well-sealed frames, the average home may have drafty or leaky
windows that could be sealed with a tracked blind. After encountering many logistical issues with a tracked system, the team decided to avoid the tracks for the first model and to ensure that the blind is properly fitted to cover the entire window. The team decided to fit the blinds to the outer frame of the window in order to completely cover the window enclosure. Though this is not the most aesthetically pleasing placement of the system, it offers the most practical option in terms of energy efficiency. With this mounting style, the blinds will come to rest against the sides of the frames when closed. This contact should sufficiently seal the window from the rest of the house and minimize airflow (infiltration and convective heat loss) through the window and blinds.

**Electronic Control System**

To take the necessary measurements and perform analysis, the team designed a wireless sensor network that offers communication between the light and temperature sensors and the blind remote system.

The most basic elements in the system are the sensors. There are three sensors in the control system; each in place to measure a different aspect of the surrounding environment. On the exterior of the house, there is one temperature sensor and one ambient light sensor, while the interior of the window assembly houses one additional temperature sensor. Each of these sensors operates in the same basic way – when connected to the controller board (explained below), the sensors are fed an operating voltage and current through physical wires. The interior components of the sensors then gauge the level of their specified measurement and output a voltage level proportional to the value detected.

The sensors are each connected to one of two controller boards. These controller boards represent the bulk of the processing and logical capabilities of the system. Their functions include supplying the sensors with operating voltage, measuring output voltage from those sensors, performing mathematical conversions of those voltages to obtain proper environmental measurements, performing the mathematical analysis to determine the optimal positioning of the blinds, and communicating with the remote to control the blinds accordingly.

There are two controller units: one inside, just above the blind casing assembly, and one on the exterior of the window. The exterior controller supplies voltage to the two exterior sensors, converts the output voltage to proper measurements, and transmits those measurements wirelessly to the interior controller. The interior controller acts as the main controlling unit in the system. It supplies voltage to and obtains measurements from the interior tem-
perature sensor. It also receives measurements wirelessly from the exterior controller. It then uses those measurements to perform the aforementioned heat flow analysis. Once the desired orientation of the blinds is determined, the interior controller sends a voltage signal to the remote, alerting it to open or close the blinds accordingly. This process of sensing, analyzing, and controlling blind orientation occurs every 60 seconds.

The final component in the sensor system is the blind remote controller. As with any common remote, this component sends wireless signals to the blinds to issue different instructions. Under normal operation, when a button is pushed, it essentially connects two ends of a wire, allowing current to flow and the signal to be sent. The team bypassed the button assembly by replacing each button with a transistor. A transistor is a component that has three connections: two signal inputs and one control input. If the control input is supplied zero voltage, no current is allowed to flow between the two signal inputs. A supplied voltage allows a connection between the two to form. By replacing the buttons with transistors, a voltage sent from the interior controller to the control input of the transistor serves to simulate the corresponding button being pressed, prompting the desired action.

**Outcome**

Though the team has been able to mount and program the system, the ecoREMOD home is still under construction and is not ready for the drape system’s implementation. Preliminary studies and experiments with the blinds suggest that it should be ready to implement as soon as the building’s renovation has been finalized, but the team cannot deliver true(definitive) results until that date of completion.

Even with the delays in construction and system installation, the team is able to test the functionality and effectiveness of the system before its final placement for ecoREMOD. The system will be installed in another location and the team will conduct tests to observe how the system adjusts the blinds to changes in environment. Some conditions, such as sunlight and temperature gradients may need to be simulated and generalized. These tests will most likely give qualitative results on the performance of the blinds and allow the team to determine the success of its basic functionality. Any recorded data on system performance will allow the team to calculate approximate energy savings as a result of the blinds’ movement, using the methods outlined by preliminary calculations.

Preliminary tests of the system’s functionality have been promising thus far. The team has mounted the system in a lab and has been able to begin calibrating the system’s functionality. Further modifications need to be made in both the algorithm design and physical system design. Once the algorithm has been successfully developed and tested in the lab, the team will determine the ideal positioning and orientation of interior and exterior sensors in order to obtain the most accurate readings for the given environment. Some of these values may be determined before construction is completed; others may require further adjustment of the algorithm after the drape’s installation.
Outside of system design, the team has been working with LEAP, the community partner, to ensure that the chosen mounting location, materials, and ideas behind the drape meet their needs. The team has consulted with the community partner several times in order to ensure that their expectations have been fulfilled. There have been several meetings dealing with educational displays, progress of construction, and LEAP’s expectations for the team and other stakeholders. Each meeting has been productive, and all stakeholders appear to be moving smoothly towards final designs for the displays in ecoREMOD.

Discussion

The complexities of a multi-stakeholder project often cause development problems. With LEAP, the ecoMOD program, the contracting company, their sub-contractors, the Board of Architectural Review, this JPC group, and other groups holding significant roles in the development of ecoREMOD, complications were bound to arise. The delay of ecoREMOD construction has shifted development and design schedules for different stakeholders, but has also given the group more time to test the drape system and work out any issues before its final implementation. At this time, the system has not been installed in its ultimate destination, and ecoREMOD’s expected completion date is tentatively set for late spring of 2011.

The design of the drape system advanced significantly since the team ordered the initial parts for the system. A better approach may have involved an earlier attempt at developing the physical system itself. Although the theoretical studies conducted earlier are important to the design, working with the physical system itself has proven to be a very important exercise, and will lead to changes in expected implementation. Despite unforeseen complications during physical implementation, the team plans to have the system ready for installation upon ecoREMOD’s completion. The team will then be able to make final adjustments to the system and analyze the drape’s effect on room temperatures and HVAC usage. Such analysis will highlight the drape’s benefits and educational values.

The team expects to develop educational materials that would allow homeowners visiting ecoREMOD to easily understand the benefits of an automated drape system. Charts that include projected energy and monetary savings for an average home with two automated drapes could be enough proof to convince most. The simplistic, hands-off nature of the system also caters to all types of homeowners. Though this system is to act as an educational tool, it could be marketed to homeowners and ultimately sold as part of a business venture.

Several members of this team, along with other students involved with the ecoMOD design course, created a potential business plan for the system in order to apply for a new funding source. The team conducted some studies to develop pricing schemes and potential marketing strategies for the drape system. The system would be purchased off-the-shelf and the sensors, remote, microcontrollers, and drape would all be purchased from their respective vendors before assembly.
The target market was determined to be environmentally conscious, middle class homeowners and lower income families looking to cut energy costs. The team ran calculations with the following assumptions:

- Drape cost (including manufacturing) of $604
- A 20% markup on the product
- Only reaching the $50,000-$75,000 per year income bracket
- Penetration of 0.01% of that market
- Third party installation
- Two systems purchased per customer

This model brought many conservative assumptions together in order to project a profit for the first year of sales. The model projected a profit of $347,904 during this first year, which is quite promising. Although the team was not awarded the funding and had not planned to sell the system for a profit, it was an interesting exercise that could bring future money into the hands of the ecoMOD or LEAP programs. Surely, the system would need to be designed, tested, and proven to work well before manufactured or sold, but these figures give the system’s future another potential direction.

This JPC team hopes that their energy savings projections, business projections, and research efforts regarding this automated drape system will benefit LEAP’s energy efficiency museum and its overarching goals of reducing energy usage in the Charlottesville area. Although there are many stakeholders involved with the ecoREMOD project as a whole, the team is most committed to satisfying LEAP and aiding its vision of a more sustainable future. The true benefits of an automated drape system may not be completely realized until a real test with large sample sizes can be conducted, but the system has promise to deliver true reduction in home energy usage, and thus, reduce the impact that home energy usage has on the environment.

**Biographies**

Matthew Jungclaus is a third year Mechanical Engineering major. He has been involved with the ecoMOD project since his first year and is a Building Performance Institute certified Building Analyst.

Christopher Greenwood is a third year Computer Engineering major and has been involved with the ecoMOD project since his second year.

Molly Tyeryar is a third year Economics and Biology major and has been involved with the ecoMOD project since her second year.

**References**


Abstract

This article explores methods of increasing the usage and adoption of sustainable technologies, namely biogas digesters, in and around Bluefields, Nicaragua. The need for this technology is motivated by several social, economic, environmental and health benefits. Several problems currently exist that prevent biogas systems from becoming a popular form of energy, particularly for the preparation of meals. These problems include learning to use the system, maintaining it and most importantly becoming accustomed to nontraditional cooking habits. In order to mitigate these issues the article presents recommendations to adapt the technology. These recommendations stem from user-experience data collected during the course of the research study. The research concludes that the recommendations made are not entirely suitable for improving the use of biogas systems in the context of Bluefields’ energy and economic landscape. Nonetheless, these improvements and recommendations may adapt well to other contexts in which biogas systems exist.

Introduction and Background

Biodigestion is the process by which manure is converted into methane gas. Biogas technology is very simple: the system consists of a large plastic bag and several pipes, which sits partially above ground in a ditch measuring between eight and thirteen feet in length. Manure from a cow or pig, is mixed with water and placed in one end of the large plastic bag. Heat and pressure act on the mixture and the products are fertilizer and methane. The methane gas produced can then be used for cooking on a household stove. Biogas systems are a relatively inexpensive replacement for traditional wood stoves. Based on a feasibility study conducted by a previous JPC team in Bluefields in 2009, a project to make improvements on the current structure of biogas systems in Bluefields was started.

The use of household biogas systems instead of these traditional wood stoves provides several economic, environmental, and health benefits. The traditional stoves are known to produce copious amounts of smoke; prolonged exposure to this smoke can be harmful, and may lead to respiratory diseases or cancers (American Lung Association, 2008). The methane cooking gas provided by the biogas system, on the other hand, produces no smoke. There are also subtle economic benefits to switching to a biogas stove. Historically, families in the rural areas surrounding Bluefields depend on the women to chop and collect the wood for use in the traditional stoves (S. Borges, personal communication, June 10, 2009) and the opportunity cost of time for this activity is high. Comparatively, the time required to collect manure for the biogas stove
is smaller, as it is frequently replenished and often found closer to home. Furthermore, our local contacts have discussed that individuals who are no longer required to collect wood can invest that time into other important activities such as family care or going to school (S. Borges, personal communication, June 10, 2009). Converting to a biogas system also means fewer negative environmental externalities. In terms of global warming, the methane released into the atmosphere from manure is around 25 times less harmful than carbon dioxide, which in this case, is produced from the combustion of wood in the traditional stoves (The Carbon Neutral Company, n.d.). The use of manure as a fuel instead of wood will also contribute to a lower rate of deforestation. While the environmental advantages of each individual system are relatively small, the benefits could be considerably great if Bluefields developed a large-scale plan for the widespread implementation of biogas.

The initial goal of this JPC project was to work in conjunction with local organizations (chiefly the Bluefields Indian and Caribbean University (BICU) and the NGOs Fundación para la Autonomía y el Desarrollo de la Costa Atlántica de Nicaragua (FADCANIC) and the Fundación Nicaragüense Cosecha Sostenible (FUNCOS) to design and construct more efficient and cost-effective biogas structures. This team initially hypothesized that the greatest obstacle to widespread adoption of biogas was financial, but following a trip to Bluefields in August 2010, however, it became clear that the issue was primarily technical. Although biogas already exists in Bluefields, and FADCANIC and FUNCOS are working to further the technology in the area, very few households have actually installed systems, and few of these systems are even used regularly. Upon returning to the University of Virginia, the team reassessed the project and established new goals based on our findings. The team hoped to modify the existing systems to make them more enticing and practical for the Bluefields families, in hopes of easing the adoptability issues of the technology. The new plan involved conducting research and basing design experiments on feedback from current users. One team member then traveled back to Bluefields in January of 2011 to present the best recommendations to the community partners in Bluefields for potential implementation.

**Methods and Approach**

The JPC team traveled to Bluefields, Nicaragua for ten days during the summer of 2010 in order to better understand the biogas systems that were already in place. Each system was installed by either FUNCOS or FADCANIC, both of which are local organizations focused on sustainable development in the area. At each site, the owner of the system filled out a survey and participated in an interview with one of the team members. The data collected and questions asked of the participants included the following: basic measurements of system size; questions and measurements regarding use of the system; questions regarding maintenance and productivity of the system. Participants were also asked for their input and recommendations on the systems, including what they liked or disliked about biogas.

Based on the results and analysis of this user survey, the JPC team developed a number of potential modifications that would improve upon the original biogas design. These modifications
were evaluated on a number of criteria including the cost of the materials, the availability of
the materials in Bluefields, and the ease of construction of the new design. These three criteria
were chosen because each contributes to decreasing the cost of the system as well as increas-
ing the availability, ease of installation, and use of a biogas system in Bluefields. After careful
analysis, a number of design modifications were selected and a complete, scale-size biogas
model was constructed implementing these changes.

The model was constructed using materials that could be easily found in the Bluefields area.
The model was then tested to ensure that the new design modifications could withstand the
pressures they would be exposed to if they were to be implemented in the biogas systems in
Nicaragua, such as pressure from the methane gas and external pressures such as weather. The
durability of the new design features were also tested in order to guarantee that the system could
withstand the elements they would also be exposed to when installed in Nicaragua.

Results

The most influential information collected was from the survey of end-user experience discussed
in the previous section. As with any project focused on engineering design it becomes important
to step back and assess and identify the real problem. It is worth emphasizing that the project
began with the intention of optimizing the process of producing biogas and minimizing the
costs associated with the construction and use of the system. As background information was
collected the scope of the project focused more on increasing the adoption and usage of the
biogas digester. This new scope is what we identified as the true problem, and identifying this
true problem was the first major breakthrough for this project.

Certain questions in the survey were clear indicators of trends in usage as well as problems that
face the widespread and frequent use of biogas systems. Below are those questions along with
common responses received during the survey:

1. **What size are the vessels used to cook in?**
   - Small vessels are used on the biogas stove - small pots for water and beans.
   - The pots used on the traditional stoves are often upwards of 1.5' in diameter.

2. **How long does cooking take for the average meal?**
   - Rarely does any one item take more than one hour.

3. **What do you like about the traditional stove?**
   - Bigger, hotter flame with capability to hold bigger vessels.

4. **What do you like about the biogas system?**
   - It doesn’t generate any smoke and requires less work to start.

These responses build upon two trends in the cooking habits of the families at the sites: groups
tend to cook large quantities at one time and users like to be able to clearly see that the stove
is functioning effectively. Cooking meals to feed four to eight people requires the use of very
large vessels, sometimes measuring up to two feet in diameter. The families found it impossible to cook with such large pots using the smaller gas stove that accompanied the biogas system. Meal preparation is a cultural habit entrenched in the lifestyles of the users; rather than adapt to the limitations of the biogas systems, many simply chose not to use their systems often. The second trend is that all the biogas systems surveyed provided an adequate amount of gas to cook all meals in a day. This means focusing on increasing the yield of the digester may not be critical in aiding the adoption of this sustainable technology. Finally, we learned that users perceived the efficacy of the cooking method directly by the size of the flame they saw upon turning on their biogas stoves.

These results are strong indicators that the use-frequency of the biogas systems can be increased by accommodating the larger, traditional vessels used for cooking. Furthermore, since the typical system produces an adequate amount of gas each day, it seems appropriate to increase the amount of gas delivered to the stove. Not only will this reduce cooking time and accommodate larger vessels, but it will also help diminish the perception of users that biogas cannot be successfully used to cook large meals.

With the goal being to adapt biogas systems to increase adoption and usage the stovetop element provided an opportunity to meet those goals. First, in order to adapt to the larger vessels commonly used, a single high-capacity burner was swapped for the prefab stove found in most biogas systems. This allowed for accommodation of larger vessels and also significantly reduced the cost of the total system. Secondly, this single burner was designed with a flexible gas tube to allow it to be easily moved. Finally, this new burner was designed to be capable of serving as a standalone on a counter-top or inserted inside a traditional stove in place of firewood. This would allow users to cook in the same way they used to, but with the energy being provided by biogas rather than firewood.

We also decided to ease the maintenance of the biogas system by designing a simple manometer to monitor pressure levels. This would allow the user to visually determine the amount of methane available without even lighting their stove. Additionally, after experimenting with several methods of sealing the plastic bag used in the system, we settled upon using heat guns to melt the plastic together, easing and speeding up the installation process.

**Discussion**

The team returned to Bluefields in January 2011 to present to the local partners the recommendations that had been developed and to obtain feedback. Although the ideas were initially well-received as the team communicated with the partners throughout the semester, implementing them soon proved to be difficult, as there were often more practical solutions already available.

For instance, the newly designed stovetop solved the issue of the current stovetops being too small for any useful cooking. However, although FUNCOS was excited by these new designs,
they had already discovered a much easier solution – simply removing one of the burners on the stove provided ample enough space for larger pots. Though this solution was not as thorough as the one suggested by the team, it was easier and far cheaper, making it ultimately a better choice for large-scale implementation.

The team’s other recommendations were met with similar reservations. Although the partners in Bluefields were impressed by the heat gun sealing method the team had devised, they opted to continue tying the bags instead using leftover rubber strips. And they decided to stick with a much simpler version of our manometer – a soda bottle filled partially with water.

After returning from Bluefields and discussing these findings, the team realized what had gone wrong. Although the team had come up with successful solutions to the obstacle of larger-scale adoption of biogas systems in general, these solutions still failed to address the obstacles to larger-scale adaptation of biogas systems in Bluefields specifically. Despite the team’s attempt to maintain cultural sensitivity throughout the project, some key aspects surrounding the cultural economics of the area had been overlooked. As long as current solutions or alternatives were working fine and achieving their goals, it is difficult to justify the added expenses or efforts of fine-tuning them. For the local partners in Bluefields, it is not worth the hassle of using heat-guns to seal the biogas systems when the current method of simply tying the plastic together with leftover rubber tubing was already successful. The team had wrongly assumed that any technological upgrade was an improvement, whereas the Bluefields NGOs were hesitant to change proven models for little returns.

The recommendations the team came up with, however, may still have useful implications. The problems facing large-scale implementation of biogas in Bluefields are likely universal, and some of the aforementioned suggestions could be implemented more readily in other parts of the developing world, where biogas is perhaps more relevant and wide-spread already. Biogas use has already reached larger-scale use in some regions of China, Africa, and other countries in Central America. There, the team would likely see a greater focus on tweaking efficiency than in Bluefields, where the focus is on basic functionality.

As the team looks forward to switching its focus to other regions where biogas can be implemented and supported, it continues to look for ways to support the biogas projects in Bluefields. At this time, this includes funding the building of new systems in centers of community activity, in hopes that this will help educate the area about the environmental issues biogas combats. The team is currently in talks with a local men’s rehabilitation center, COPRAJ, where a biogas system will be built with support from FUNCOS. The system will be funded by the team and will hopefully implement some of the design modifications discussed earlier. Regular feedback will be provided by COPRAJ and this information will be used to further analyze the practicality of the biogas systems and the team’s recommendations.
References


Biographies

Ben Erban is a second year student studying Civil and Environmental Engineering. His experience and knowledge in civil and environmental engineering(these fields) has been a great asset for this JPC project. Ben hopes to pursue an engineering career in the civil and environmental fields after completion of his undergraduate studies.

Elizabeth Broderick is a fourth year Economics major with a Global Culture and Commerce minor. She was involved with a previous JPC team last year working on a feasibility study in Bluefields, Nicaragua. Elizabeth interned at the Carbon Neutral Company in London last summer, and hopes to work in the renewable energy sector after graduation.

Ashutosh Priyadarshy is a third year Electrical Engineering major with an Applied Mathematics minor. He has been involved in the JPC program as the Social-Committee chairperson. Ashutosh is interested in digital signal processing and hopes to pursue further studies in electrical engineering after graduation.

Philip Rinehart is a third year Systems Engineering and Economics major with an Engineering Business minor. In addition to being a member of a JPC team, he is also a member of the University of Virginia Global Business Brigades organization. Philip is interested in working in the consulting field after graduation.
Abstract

The Cavs & Panthers program is a mentoring and enrichment partnership between the University of Virginia and Red Hill Elementary School. The program consists of weekly one-on-one academic assistance sessions and twice-monthly Friday field trips and in-school enrichment activities. The program is designed to provide students with a safe and encouraging environment in which they can embrace new experiences and take risks with the security of a trusted mentor by their side. The past year’s broadly framed JPC research informed the selection of a narrower research focus this year: academic self-efficacy, or a student’s belief in his or her academic abilities. Given the time limitations of any after-school program, it is essential to study the changes in attitude that will help lessons learned during the program carry over to the school day. Changes in a student’s perception of his or her ability to succeed tend to be difficult to quantify and thus the primary method of research was the collection of qualitative field notes. These notes are the basis for an understanding of how the elementary students perceive their own abilities, and the team identified key themes of encouragement, possibility of dependency, and making learning experiences out of many activities. Because Cavs & Panthers lasts the entirety of the academic year, the conclusions represent the best analysis of the limited results available at this time. The results are instructive to the continuous improvement of the program’s ability to meet the Red Hill students’ needs, and lessons from this specific program could be generalized to many programs.

Introduction

Every Wednesday at two-thirty in the afternoon, twenty-five students from the University of Virginia load into their cars and trek fifteen minutes down Route 29 to Red Hill Elementary School. A scenic drive connects the two schools that, while a short distance away, can feel worlds apart. On the other end of the road, twenty-five elementary students eagerly await the arrival of the Cavalier students, and both groups harbor excitement for the afternoon ahead.

Since its inception over two years ago, the Cavs & Panthers Mentoring and Enrichment Program has grown both in size and depth. The budding program for academic help that started in the spring of 2009 blossomed into a full mentorship and enrichment program, and in the fall of 2009 a research component was added to the program. This research began with a broad focus: to study the academic, social, and behavioral impact of the program on the mentees. During the course of that research, the JPC students noticed that mentees were able to identify many of their own weaknesses but few strengths. For this reason, the team decided to pursue a more fo-
cused research question framed by the concept of academic self-efficacy, how students perceive their own ability to be successful in school (Bandura, 1977). The insights of Stanford psychologist Albert Bandura, who has conducted significant research on the topic of self-efficacy, offered a helpful perspective to the JPC team (Parajes, 2001):

Bandura painted a portrait of human behavior and motivation in which the beliefs that people have about their capabilities are critical elements...how people behave can often be better predicted by the beliefs they hold about their capabilities, which he called self-efficacy beliefs, than by what they are actually capable of accomplishing, for these self-perceptions help determine what individuals do with the knowledge and skills they have (p.242).

This “portrait of human behavior” led the JPC team to wonder how an after-school program could affect the academic self-efficacy of students. The importance of this question is not to be understated. As mentoring programs are limited in scope, they must produce attitude changes within the students in order to have lasting results. Our belief is that the students’ perceptions of their own abilities are ultimately the source of such lasting attitude changes. Therefore, the true end that Cavs & Panthers hopes to achieve is to heighten the students’ self-efficacy beliefs, equipping them with the means by which they can succeed. Following the research of Bandura, the team set out to raise students’ self-efficacy beliefs primarily by encouraging them and by using verbal persuasion techniques, which he considered a core mechanism of improving self-efficacy. In addition, mentors used pointed questions in order to ensure that the students developed a sense of personal mastery over the subject matter (Bandura, 1977). We believe this sense of mastery is the catalyst that will lead to increased self-efficacy in students.

In his study on the relationship between self-efficacy and academic achievement, B.J. Zimmerman discovered that “self-efficacious students embrace more challenging goals” (Zimmerman, 2001). Our hope is that by prompting an initial increase in students’ self-efficacy beliefs, they will consequently embrace new challenges and overcome them, leading to even higher degrees of self-efficacy and achievement.

While we believe that this technique will ultimately lead to increased achievement in the classroom in the long run, research shows that it has numerous other benefits as well. As mentees and mentors work together over the course of the year and mentors encourage mentees to tackle the academic challenges thrown their way, a strong bond between them often develops. Research has shown that “[students] who reported having had a strong mentoring relationship during adolescence exhibited significantly better outcomes within the domains of education and work, mental health, problem behavior, and [general] health (Rhodes & Dubois, 2008). Because of this, the Cavs & Panthers program is designed with the goal of deep mentor-mentee relationships as a central feature.

These relationships are facilitated by incorporating two different kinds of meetings between mentors and mentees into the program. These meetings consist of weekly Wednesday afternoon mentoring sessions and bi-weekly Friday afternoon enrichment activities. Each Wednesday mentoring session contains two principal components: academic help and a group activity. After a
time for a nutritional snack and conversation, twenty-five mentors work one-on-one with twenty-five mentees, who have either signed up voluntarily or been recommended by parents or teachers, focusing on developing better approaches in identified areas of academic need for nearly an hour. With twenty minutes left in the afternoon, all the groups meet in the gym for a stimulating group activity that seeks to strike a balance between increasing self-efficacy and fun. During the Friday enrichment activities, the students and their mentors alternately enjoy a field trip or an enrichment activity at the school, exploring the possibilities in Red Hill’s backyard and beyond. During these sessions, one would never recognize that the students represent a small, rural Title I school with nearly 50% of students coming from economically disadvantaged backgrounds and nearly 16% of students with disabilities, with an even higher proportion of each in the program.

Methods

The methodology used to track the impact of this yearlong project on academic self-efficacy is primarily qualitative in nature. First, participants responded to a brief survey designed to test their views of their own abilities in school. This survey was used to identify potential participants for further consideration during the next phase of the research. The JPC team then hired a student with experience in qualitative note-taking to observe the program as a whole and take detailed notes focusing on three mentor/mentee pairings. The advantage of utilizing an observer external to the team lies both in increased objectivity and in avoiding the need to give up time as a mentor, as all of the authors are also involved as mentors. With the program halfway complete at the time of this submission, current results serve as only a snapshot of the final results. Through the hours of in-depth field notes, the team’s own observations and experiences, and a thorough review of prominent literature in the fields of mentoring and self-efficacy, the team sought to answer questions of the impact of this program on the students’ academic self-efficacy. Specifically, the qualitative lens has allowed the team to hypothesize key practices that show how the program can improve academic self-efficacy.

Preliminary Results

The observations from the field notes were important in obtaining an in-depth outside view on the program. Accounts of numerous episodes of both successful mentor/mentee interactions and interactions with more friction shed light on and provided concrete examples of broader trends in the impact of the program on students’ academic self-efficacy. Broadly speaking, the field notes showed instances of encouragement and reinforcement to their mentees, as evidenced by the following occurrence:

*Mentee A and mentor, C are playing a game in the gym with another mentor-mentee pair (mentee B and mentor D). When the mentees make a shot, they must complete a math problem to receive the number of points based on a correct answer to an arithmetic problem.*

*Mentees A and B are a bit impatient, but continue to play along.*

*A and B dance while they wait for their problems. Appear excited, impatient but engaged.*
Mentors C and D use lots of reinforcement and encourage them when they get an answer wrong or miss a shot.

In general, there were frequent instances of encouragement and reinforcement, as above. The field notes show further instances of mentees sighing or appearing dejected before encouragement from a mentor helps them make another attempt at a difficult problem. As in the above exchange, the frequent presence of encouragement in the face of failures and the absence of any instances of mentors failing to provide encouragement seem to indicate successful implementation of these good mentoring practices. A further general observation is that the mentors sought to not simply provide students with answers, but to be patient and support the students in their efforts to find the answers themselves. This exchange also illustrates how the mentors in the program creatively try to make learning experiences out of games like basketball and, in other instances in the field notes, chess.

Running counter to the above observation are instances where mentees appear to rely on mentor response or help. When attempting to sound out a difficult word, one mentee makes multiple attempts to sound it out, each time looking into his mentor’s eyes for confirmation. Other mentors report that the students often guess and search for confirmation as opposed to arriving at an answer with conviction. Furthermore, there are several indications of reward systems being necessary to encourage focus and effort, what one mentee referred to in an excerpt as the “if-you” game: “If you do this, you’ll get that”.

Discussion

In-depth review of the field notes led the team to consider three key themes in its reflection on the program: encouragement, dependence, and creating opportunities for learning experiences. The team was pleased to find in the field notes several accounts of mentors being deliberate about creating a friendly and encouraging environment for the students. While these observations are not conclusive evidence of the effectiveness of the program, but rather snapshots along the road of a yearlong program, the field notes show evidence that Cavs & Panthers has remained true to its goal of creating a nurturing and encouraging environment where students can feel free to take risks and try new things without the fear or failure or reprimand. Creating an environment in which failure is tolerated is thought to be important in supporting academic self-efficacy (Parajes, 2001). Moreover, verbal persuasion, performance accomplishments, and vicarious experiences of success are thought to be primary means of increasing self-efficacy beliefs, and thus were incorporated extensively into our program (Bandura, 1977).
The field notes also brought an unexpected conclusion that adds another level of insight to the program’s approach to increasing student self-efficacy. One note pointed out that while the students generally seemed to thrive in the environment of encouragement created by the mentor, it also ran the risk of leaving the students dependent on their mentors for assurance or for rewards. After an instance in which a mentee seemed to search his mentor’s eyes often for approval, encouragement, etc., the observer wondered:

*Does the pattern of using the mentor to help with academic work increase the mentee’s ability to do the work on his/her own? Or does it increase mentee’s reliance on adult/mentor figure?*

*Many of these relationships seem trusting/successful.*

*Would a mentee with a particularly successful relationship with mentor become increasingly dependent on the mentor to feel successful?*

In essence, this could mean that any increases in the students’ self-efficacy were really only specific to the environment of the program in which they received constant encouragement or a reward from their mentors. If this is the case, it certainly poses a problem, as it suggests that the students may not be able to carry those increases in self-efficacy back to the classroom where the mentors aren’t there to encourage or provide rewards. In fact, this dependence may even pose the risk of lowering the students’ self-efficacy in the long run because it suggests that the students’ perception of their own abilities is not rooted in the realization of their actual skills, but instead in their mentors’ responses.

A final theme the team noted was the prevalence of the creation of learning opportunities out of everyday activities like chess or basketball, allowing for learning that went beyond the activity itself. Mentors appeared aware that, for example, the learning fostered in playing chess can be activity-specific, as when one only learns narrowly applicable tactical moves, or more broadly useful, as when mentees learn approaches and attitudes (such as “thinking two steps ahead”) that will help them in numerous activities and tasks.

The two years of research through the Jefferson Public Citizens program have confirmed how essential reflection is to community engagement. With this in mind, the team will work to develop stakeholder surveys that can be used to gauge program impact and satisfaction among all involved parties: mentees, mentors, teachers, school administration, and parents. The future leaders of the program will continue to use these to improve the program and solicit input from all corners of the Red Hill community.

The primary community benefit of the project is its weekly mentoring sessions, which provide meaningful interpersonal interactions that engage elementary school students with university students and university students with the Charlottesville community. Through these sessions, the program provides Red Hill students with additional help and personal attention in areas of academic need. It appears to have created an encouraging environment in which they could
feel free to take academic risks and make mistakes without fear of failure. Inherent in this is the relationship between the students and mentors, as it was the bond and the trust between student and mentor that allowed for this encouraging environment to develop. Furthermore, the enrichment trips provide these students opportunities to connect fun, engaging experiences in the Charlottesville area both to what they are currently learning and to future aspirations.

To focus only on the way the program benefitted the children would be to disregard the two-way street of the mentoring relationship that Cavs and Panthers seeks to foster. The mentors from the University of Virginia benefit from the Cavs and Panthers program in numerous ways as well. Mentors say the program provides a refreshing break from the week, an interesting look outside the “bubble” of the University, and a meaningful way to apply leadership, academic, and interpersonal skills in a community setting. Even more, psychology studies have shown that volunteering and giving time to the helping of other people equates to greater happiness and life satisfaction as well as lower anxiety in the short run (Borgonovi, 2008). The program contributes to the development of mentors as citizen-leaders regardless of their plans for their future careers.

The benefits to the broader Red Hill community are somewhat more difficult to identify. Being a small school situated in a rural setting, the sense of community there is already very powerful. The principal knows every student at the school by name, and many families at the school already know each other well. The community showed its strength during a debate about whether to close down a number of rural schools in Albemarle County in favor of a larger, more centralized schooling system. We were able to help in this instance, as one data point the principal reported back to the school system with pride was the large number of volunteer hours at Red Hill—Cavs and Panthers contributed over 1000. The program does create a community within a community at the school, bringing together students and teachers who would not otherwise have a great amount of contact during the busy school day, and allows the incredibly dedicated faculty of Red Hill, who have always been supportive of the program, additional time to connect to and support students.

The results and benefits of the program and the research must be assessed in light of the many limitations we faced. Many limitations, such as limited sample size and time restraints, are common to all student projects and need little elaboration. There were, however, a number of limitations specific to the Cavs & Panthers program that deserve deeper analysis. One challenge is the mentors themselves, as none of them (including the JPC team) are professionals in mentoring students but are simply college volunteers. While they all have a proclivity to working with children, this inexperience with mentoring means that the college students, at times, lapse in displaying model mentor behavior. Such moments have the ability to hinder the formation of strong bonds between mentor and mentee and can impede the establishment of an environment conducive to the growth of the student’s self-efficacy (Bandura, 1977).

Perhaps one of the biggest limitations of the program is that, due to academic scheduling con-
fects, not every mentor is able to volunteer with Cavs & Panthers during both the fall and spring semesters of the school year. Because of this, we found instances where a mentor would form a strong relationship with a student in the fall and then be unable to return for mentoring in the spring. This can be difficult for students as it creates for them an environment of uncertainty and undermines the mentor-mentee relationships that are essential to the approach of developing the students’ self-efficacy (Rhodes & Dubois, 2008).

Conclusion
As with any program in community engagement, approaching the Cavs & Panthers program with a sense of humility is essential to its success. The observations show not only how crucial, but also how difficult it is to engage in specific mentoring interventions that carry over into mentees’ time outside of the mentoring program. While the identified theme of dependence looms large, it is hoped that the encouraging environment and rich learning experience will foster growth in the students that will indeed stay with them.

Our reflections lead us to a few preliminary hypotheses to pursue in shaping a mentoring program that fosters lasting change in academic self-efficacy. First, mentors should seek to guide and support mentees through questions, and avoid giving mentees answers or allowing mentees to guess their way to an answer with mentor support. Second, the program emphasis should be on creating a culture of encouragement in which failure is acceptable, so long as one tries again. Third, mentors should, where possible, focus on teaching more broadly applicable concepts that can be used in multiple situations as opposed to merely situation-specific methods or skills. The JPC team hopes that its approach to mentoring leads to students who believe in their abilities to take on academic challenges, who push themselves forward, and who are equipped with the skills to build their own bridges for success.

Biographies
Anna Fairchild is a second year student who hopes to enter the Curry School of Education in the fall.

Max Gruenther is a third year student studying Economics.

Kevin Pujanauski is a third year student studying Politics Honors and Global Development Studies.

Justin Zeidman is a second year student studying Economics.

References


Women’s Health Education on the Tibetan Plateau

By Gongsalamu, Saamia Noorali, Anna Sosdian, and Rachel Vaughn

Abstract
There is a dearth of basic health knowledge on the Tibetan plateau due to a lack of health education and basic medical infrastructure. Combined with a cultural silence surrounding women’s health concerns, the situation on the plateau is that many Tibetans face serious yet preventable health problems. The “Women’s Health Education on the Tibetan Plateau” project team attempted to address this problem by partnering with the Tibetan nonprofit Shem Group in hosting a week of health training sessions for young Tibetan women. These sessions equipped the participating girls with classroom training and health resources to share with rural Tibetan women in their home villages. While the project met its goals in terms of content and implementation during the trainings, the team faced serious communication challenges, particularly before and after the training. The implementation of projects like “Women’s Health Education” may be effective, but the long-term benefits are difficult to measure given institutional, political, geographic and language barriers.

Introduction
The “Women’s Health Education on the Tibetan Plateau” project was conceptualized through conversations among Jefferson Public Citizens group members, the two non-profit organizations Machik and Shem Group, Tibetan scholars and professors at the University of Virginia. The project was based on the history of engagement between the University of Virginia and Tibet, and added to new perspectives to that relationship from Shem Group, a women’s association that seeks to empower Tibetan women through grassroots development. Shem Group operates in Xining, Qinghai Province on the northeastern Tibetan plateau, a city with one of the smallest economies in China in a region where the majority of the population is engaged in nomadic herding or subsistence farming. In the surrounding rural area, problems of rural isolation, economic scarcity and inadequate education contribute to a drastic lack of health care availability and knowledge of basic hygiene and health practices. Research done by the Tibetan Healing Fund found that none of the rural female respondents to a survey had any knowledge about Hepatitis-B or Sexually Transmitted Infections (STIs), including HIV and AIDS. In addition, none of these women knew how any of the diseases were contracted or how they could protect themselves against infection (Foggin, Torrance, Dorje, Xuri, Foggin, & Torrance, 2006). There is a clear problem in the Tibetan regions of China regarding knowledge about health, particularly among women.
This issue is linked to a lack of educational opportunities in the region. Relatively few Tibetans are able to complete six years of primary education, let alone the full nine years of compulsory education (Foggin, Torrance, Dorje, Xuri, Foggin, & Torrance, 2006). The remote geography of the Tibetan plateau means that students have to travel long distances to reach school, and in many cases have to attend a boarding school to receive a high school education. To go to college, students have to travel even further to regional capitals where universities are located.

Inspired by the work of Machik to redress educational inequality on the Tibetan plateau, the JPC Tibet team took on the problem of women’s health education. The original proposal partnered with Machik to do research into healthcare, but due to the politically sensitive situation in China, the team had to rethink its concept. Through its Machik connection, the JPC Tibet team was able to collaborate with a nonprofit organization working on the Tibetan plateau, Shem Group, to develop and implement resources and programs for a 5-day women’s health training in Xining targeting young women. The goal of the project was to communicate health information to young students and empower them to share their new knowledge with their local communities.

The project had three phases. The first was US-based archival research into best practices on gender sensitivity training, development of women’s health care resources for the training, research on different methods for running workshops and documentation of case studies on such training in other parts of the world. The second phase was in Xining, working with Shem Group to finalize the training program. The third phase was the health training itself. This five-day program addressed 40 college-aged women and 60 high school girls. The objectives of the training were to educate young women about reproductive health, sexual health and general hygiene, and to provide them with resources to educate their peers.

Each participant was asked to share the information that they learned in the training with ten other women in her home village, and each was given a kit with resources to help them achieve this goal. The objective of these kits was to break down silence about women’s health issues in rural areas and to share accurate health information through informal social networks in villages. Given political considerations and language barriers, the JPC team was unable to hold training in a rural area, where health information is most needed. It was hoped that this method of peer information sharing, and a “teach the teacher” model within the training would achieve the ultimate goal of disseminating health information to rural women.

As part of the health kit, the JPC team created a monthly calendar that visually conveys health and hygiene information with a different health theme for each month. These calendars serve as reminders of the health information for participants, who were given the calendars after the training. The calendars were designed to be visually appealing and culturally acceptable, and therefore are more likely to be displayed in the home as a decoration.

The training itself was evaluated at the end of each session by anonymous participant surveys. Shem group agreed to follow up with participants to ensure they completed their outreach to ten other women and received a report from each participant detailing her completion of the outreach.
Methods

The conference began with a session for college aged students held on the nights of July 7, 8 and 9, 2010, and ended with a session for younger, rural high school students held during the days of July 10 and 11, 2010. Two experienced female doctors, specializing in women’s health, were invited to teach the technical portions of the training.

The doctors covered a wide range of topics in a short period of time, including reproductive health, birth control, pregnancy, STI prevention, puberty, menstruation, first aid, nutrition and personal grooming. In addition, the doctors covered some basic hygienic knowledge such as washing hands, usage of sanitary napkins and the importance of underwear to promote health. Most participants did not have any formalized health education before the conference, so the doctors illustrated all topics and ideas with simple descriptions and pictures. For instance, when explaining STIs, the doctors used slideshows of pictures of genitals transformed by STIs to demonstrate symptoms. When the team met with Shem Group to plan, the women shared that in previous trainings participants had many questions for the doctors. Therefore, the team planned time for questions at the end of every session, distributed slips of paper and provided a question box so participants could ask sensitive questions anonymously.

The JPC project team felt it was important to include activities that would allow the students to actively participate in the training. Therefore the training began with a community needs assessment activity. Participants formed groups with a UVA student and a Shem Group leader and mapped problems that Tibetan women face onto a poster of a tree. The most pressing problem was written on the tree trunk, the causes of this problem were written onto the roots; symptoms were written as the branches, and solutions to the problem were written as leaves. Participants took turns presenting their results to the entire group.

After the doctor had introduced the participants to STIs, six volunteers came to the front of the room and received cards with descriptions of different STIs. Six other cards were passed out to other participants with the names of these STIs. Each volunteer at the front of the room read her STI description. Then, whoever in the audience had the corresponding STI card raised her hand and said which STI was being described.

Participants learned how to make reusable cloth menstrual pads in a project conceptualized with Shem Group prior to the training. Reusable cloth pads could provide a sanitary option for menstruating women without access to disposable pads in rural areas of Tibet. Machik, a Washington, D.C.-based nonprofit, is currently looking into implementation of a social business model that would provide similar pads to rural women. Therefore, this section of the conference was designed as a first step to test these ideas, as well as a way to pass on knowledge of reusable cloth pads to participants. After research and prototyping, the team found a design that was simple and easy to hand-sew, purchased local materials for construction and designed visual and written instructions in Mandarin Chinese. During the training, the participants were provided with materials and were taught how to sew their own pads.

One of the essential parts of the project design was a health care calendar illustrating the follow-
ing subjects in a culturally sensitive manner: burns, cuts, babies and toddlers choking, boiling water, expiration dates, TB, immunizations, pregnancy, adult and child nutrition, and immunizations. After reviewing images with Shem Group, the design was modified to include pictures of food that were most commonly found within the region and the illustrations of pregnant women were changed from nude to clothed. The captions in the calendar were in Tibetan and Chinese and the numerals were Tibetan.

The JPC team used a peer health education model in the health training, in which participants were asked to sign a contract agreeing to share what they learned with their friends and family. Two expert doctors presented on a variety of health topics, but the project team came up with activities, materials and resources to supplement their presentations.

These resources were bundled into Health Kits for the conference participants to take home and use to share their learning with the community. The kits included brochures about STIs and birth control, a “Teen Survival Guide”, free condoms, underwear and pregnancy tests, a first aid kit and a health encyclopedia. Participants used other resources to reinforce learning during the conference, including the pad-making kits and a homework assignment on the female reproductive system. The calendars were originally meant to go in the health kits, but due to printing delays these were distributed to participants after the end of the project.

Free condoms and pregnancy tests were included because condom and pregnancy test demonstrations were a part of the training, so participants needed a take-home example to use or give to a friend. The high school girls were not provided with free condoms because it was determined with Shem Group that it might not be appropriate. Underwear was provided to all participants because in rural areas many women do not have this or any sanitary items for their menstrual period. The health encyclopedias were chosen because they cover a large amount of material while also being visually interesting and easy to read. The participants can refer to these encyclopedias when they have health questions or concerns.

Results

In the evaluations at the end of the training, almost all the participants graded the doctors’ presentations and demonstrations highly. Some participants had problems understanding the Chinese used in the doctor’s presentations, especially the high school girls. The majority of students expressed that they had learned a lot from the conference and agreed to share the knowledge with their families and friends.

One of the issues in the Community Needs Assessment activity was the language barrier. When the JPC team tried to actively participate in the discussion and presentation, it was detrimental to the participants, because the team’s words had to be constantly translated into Chinese or Tibetan, taking time away from their participation in the activity. The use of English also seemed to make more girls shy or reluctant to participate. The Shem Group staff shared this feedback with the JPC team after the first day, which resulted in greater participant leadership and a corresponding higher enjoyment of the activity reported in the end-of-the-day surveys.
The STI card activity depended upon the willingness of each volunteer to be vocal and knowledgeable of the STI card she held. The university participants actively participated and did well in matching STIs to descriptions. The high school girls were less willing to volunteer and to speak loudly and clearly, perhaps due to shyness, the delicate nature of the subject matter or less familiarity with Mandarin Chinese.

The JPC team observed that the high school girls were very enthusiastic about the idea of the cloth pads, and worked hard to sew them well and get a good final product. For the university girls, there was less enthusiasm, perhaps because there was less perceived need for the pads. This may be because the university girls are accustomed to living in an urban setting with easy access to disposable pads while the high school girls were living in more rural areas or had stronger ties to families living in rural areas with little access.

Discussion

The JPC “Women’s Health Education” project team brought a number of different perspectives to the table, which proved to be both an asset and a challenge to the project. Three team members shared a Global Development Studies major, which gave them a common intellectual background, but had different life backgrounds and interests. One team member had a pre-medical background and an interest in art, and had lived in Pakistan and the US. One team member had led international trips for students and had extensive development and leadership experience at UVA. Another had a health promotion background, had studied in India and was from Virginia. The last was from Lhasa, Tibet, had attended a Chinese boarding school and had an economics background. This diversity meant that the team had a diverse skill set to approach the project, but the team lacked a cohesive leadership strategy.

In the US, the team felt that there was not a need to plan a management style, since most of the project planning was done in a congenial, conversation-based decision making style during weekly meetings. The founding three members all share assertive personalities and have no problem holding their own in discussion, and when conceptualizing the project, this led to a creative exchange of ideas. However, the fact that two other group members decided to find another project in the planning phase because they felt unheard should have been a warning sign. While the Global Development Studies class that most of the group took when developing the project explicitly stated that personal conflicts could derail projects, this team assumed that because relationships were positive at the time, they would always be so. When the team arrived in China and had to face the realities of problem solving on the ground, the diffuse leadership style turned into a hindrance. When conflicts occurred, the strongly assertive personalities in the team caused impasses where there should have been compromises.

With three strong personalities and no previously agreed-upon plan for conflicts, the previously congenial group dynamic became contentious. The group did not spend time addressing these conflicts, but instead focused on completing the project successfully. While the training was very successful, the breakdown in team dynamics ultimately hurt the project’s long-term success. Once the team left China, instead of coming up with a cohesive strategy to end the project, the team collectively focused on other individual priorities. Conflict management is
an essential life skill, and the JPC project was an experimental lesson in it for the entire team.

Cultural differences in communication also impacted much of the logistics of this project, especially when it came to the budget and reimbursement. A major difference between the United States and China is that in the US, everything is done on credit, with reimbursement promised. In China, money is advanced, with excess returned. It was quite challenging to ask Shem Group to change their entire operating system and adopt the JPC budget process for our benefit. The JPC program might do well to examine how to make their budget process more flexible to local cultures. There were also differences in the team’s email style and that of Shem Group. Operating on the UVA culture of constant contact, most of the team is highly responsive to email, while Shem Group replied less frequently. For example, in the month before leaving for China, the project team had difficulty getting in touch with Lhamotso, the Shem Group member working in D.C., about the calendar design and other details of the trip. The team’s advisor, David Germano was in Xining in May and was able to meet with Shem Group on the group’s behalf. Since a team member had to take on all of the work of designing the calendar and all the material had to be translated into Tibetan and Chinese, its production took much longer than expected, causing the calendar not to be ready in time for the conference. This illustrates the impact communication difficulties had on the project.

It was difficult for the three English-speaking team members to get around the city without help from Lala or a member of Shem Group. There was also an imbalance of leadership between the three American team members, who had more development and health experience, and the Tibetan team member, who had cultural and linguistic fluency that became essential on the ground. This dependence made some activities, like shopping, very time consuming. The lack of fluency made the team’s role in the conference more limited, as it was time consuming to translate from English to Chinese, and necessary for Lala or the Shem Group members to address the participants. Despite these difficulties in communication, the team members were still able to establish good will with all the participants and Shem Group volunteers.

The project faced limitations in the amount of quantification possible. The original project proposed more quantifiable research into health access on the Tibetan plateau, though the original community partner, Machik, could not work with us because they were concerned that sponsoring a US research project that could be construed as critical of the Chinese government was too risky for an organization run by Tibetans in exile. This led the team to find a local community partner in Shem Group and redesign the project concept to something less controversial. The crux of the new project was the health training. However, time and language limitations made quantifying the results of the project much more difficult. To get data back from Shem Group required that the participants fulfill their part of the contract and mail a description of their community outreach to Shem Group, that Shem Group translate their responses and email the results to the team in the US. This is a considerable burden to place on a working organization that has its own priorities; therefore the team is waiting for the results to be sent when Shem Group has the time to finish them.

Furthermore, because of language barriers, it was difficult to assess how the girls were receiving the information as it was given and how beneficial they found it. Each completed a brief survey
at the end of day, but due to cultural norms, they may have deemed it inappropriate to state anything negative. Even if Shem Group were to send their translated evaluations, the influence of cultural values may make it difficult to ascertain the impact/usefulness of the conference, in addition to other hindrances natural to translation.

**Biographies**

Gongsalamu (Lala) is a third year Economics major with a Finance concentration from Lhasa, Tibet.

Saamia Noorali is a fourth year Global Development Studies major from Pakistan and Virginia Beach.

Anna Sosdian is a fourth year Political and Social Thought and Global Development Studies double major from Arlington, VA.

Rachel Vaughn is a fourth year Global Development Studies major from Richmond, Virginia.

**References**


Adapted Creative Movement for Children with Physical, Intellectual, and Developmental Disabilities

By Casey Brown, Amy Copeland, Emily Lee, and Latasha Nadasdi

Abstract

This study assessed the benefits of creative movement for children with varying disabilities. We used the Social Responsiveness Scale and a novel Laban Movement Analysis evaluation system to measure the changes in a child’s movement and social skills over the span of five weekly adapted creative movement classes. We hypothesized that participation in the program would change a child’s movement quality and phrasing and improve his/her social skills. Participants included four children, ages 6-9, with varying physical, intellectual, and developmental disabilities. Due to constraints, we did not conduct analyses on the movement hypothesis in time. We saw improvement in social skills for some children, but results did not fully support the association of improvement with participation in the classes. We gained knowledge particularly on curriculum development which was beneficial for the community partner. This paper will discuss limitations and future directions.

Background

Children with disabilities are often unable to participate in community activities because they may struggle to keep up with children without disabilities (Fragala-Pinkham, Haley, Rabin, & Kharasch, 2005). Movement limitations and social difficulties may prevent participation in dance classes at local studios generally tailored toward children without disabilities. Dance/movement therapy (D/MT) geared toward participants with disabilities focuses on confronting present physical limitations and creating an accepting atmosphere (Sandel & Hollander, 1995). For those near Charlottesville, Kluge Children’s Rehabilitation Center (KCRC), part of the UVA Health System, offers adapted dance classes.

Researchers have examined D/MT with children with various physical and mental disabilities. They studied D/MT in children who are hospitalized (Mendelsohn, 1999) and who have social, emotional, and behavioral difficulties (Goodgame, 2007), physical disabilities (Duggan, 1978), and developmental disabilities such as autism (Cornman, 1997). Hospitalized children undergoing D/MT may perceive their handicap as greater than in reality; D/MT has been shown to help them discover their full movement potential (Mendelsohn, 1999). D/MT may improve symptoms in those with autism (Cornman, 1997).
Movement has psychological implications and can communicate unspoken messages about oneself, thoughts, and emotions (Levy & Duke, 2003). Children often mimic the movements and expressions of those closest them and use them when communicating with peers (Frith & Frith, 2006). This is important in future relationships, social and otherwise, for understanding others' actions and being able to empathize (Thom, 2010).

**Problem and Purpose**

After seeing creative movement's prevalence in D/MT literature (Mendelsohn, 1999; Goodgame, 2007; Cornman, 1997; Thom, 2010), we felt that its addition to the KCRC curriculum could be beneficial to the children. Previous classes focused on structured teaching of technique and movement phrases, and we observed that it proved difficult for some children with unique disabilities. We saw creative movement as a solution to this problem because it gives children freedom to move however they want, allowing them to explore their abilities rather than reinforcing their disabilities (Mendelsohn, 1999). It may therefore be more beneficial to children with disabilities than trying to conform their bodies to traditional dance movements. However, previous studies have not measured D/MT's effects on movement quality. We partnered with the recreational therapist that teaches the adapted dance classes to investigate creative movement as therapy for children with disabilities. We aimed to contribute material to a future curriculum while examining the relationship between participation in creative movement therapy and participants' movement and social skills.

**Hypotheses**

**Hypothesis One: Movement Quality**

We hypothesized that creative movement would improve and diversify the children's movement and phrasing patterns. We used Laban Movement Analysis (LMA) to evaluate changes in both.

**Hypothesis Two: Social Skills**

We hypothesized that creative movement classes would improve children's social skills according to a standard measure of social functioning.

**Methods**

**Participants**

Participants were four children between ages 6 and 9 from the Charlottesville, Virginia community. This population included a variety of disabilities which collectively involved coordination difficulties and social deficits. Privacy concerns prevent disclosure of demographic or diagnostic information. We recruited participants through KCRC, local hospitals, doctors, schools, and churches. Participation was voluntary, and we covered the cost of the class. All participants' parents consented, and all participants assented prior to participation.
Measures

Laban Movement Analysis

LMA consists of four Elements—Body, Effort, Shape, and Space. Using it includes discussion on combinations of Elements and their integration in phrasing patterns. Body is primarily concerned with the organization and connections of body parts. Certain movement pathways are important at each level of development and compensating for them with other movement pathways, rather than embodying them, can lead to subsequent physical or psychological problems. Effort describes movement's texture, reflecting the inner attitude toward investing energy. Shape involves changing body position to create relationships with the environment or others and investment in shape changing. Spatial intent organizes body connections by establishing clear pathways or goals of movement (Hackney, 2002).

LMA Evaluation System. Two Certified Laban Movement Analysts (CLMAs) evaluated participants’ movement in selected weekly footage. CLMAs normally provide narrative analysis, so we designed a novel evaluation system quantifying LMA using a modified Likert scale with space for additional narrative analysis. The CLMAs we consulted felt this system appropriately captured LMA and would feel comfortable using it. It consisted of 39 items covering the Elements.

The Social Responsiveness Scale

The SRS, a 65-item parent report rating scale, evaluates a child’s social behavior in terms of five subscales—social awareness, information processing (cognition), communication, motivation, and autistic mannerisms. It uses T-scores (population mean = 50, standard deviation = 10) for measurement with higher scores indicating greater impairment. Although used in identifying autism spectrum disorders (ASDs), it can also evaluate social impairment in children with other psychological problems (Constantino & Gruber, 2005).

Procedure

At the initial consent/assent meeting, parents filled out the SRS. Children had the opportunity to participate in five filmed weekly classes (45 minutes each) at KCRC. We paired each child with volunteers.

Classes began with a beach ball name game, five minute free dance, and stretching. Free dance exercises began each class, and their purpose was to show baseline movement uninfluenced by outside suggestions. Each class had an LMA-based theme. Themes included space and size, force, focus, and body parts and body shapes. The last class reviewed these themes. We adapted exercises from Creative Dance for All Ages (Gilbert, 1992). Every class included an exercise involving peer interaction. We finished each class with a dance phrase that we expanded weekly to include new material pertaining to that day’s theme. After the last class, parents filled out another SRS. CLMAs evaluated footage using the LMA Evaluation System.
Results

**Hypothesis One**
Time constraints prevented analysis of these data. Please see *Future Directions* for information regarding future analysis.

**Hypothesis Two**
Participant 1 displayed clinically-significant improvements in social communication, social motivation, and overall social functioning. Participant 2 showed clinically-significant declines in both social communication and social motivation. Participant 3 displayed clinically-significant declines in social awareness, social communication, autistic mannerisms, and overall social functioning. Participant 4 showed clinically-significant improvement in social cognition, autistic mannerisms, and overall social functioning (Table 1).

Discussion

We could not assess hypothesis one, that participation would be associated with greater diversity in movement quality and phrasing, in time for publication. Our data did not strongly support hypothesis two, that participation would lead to improvement in measured social skills.

Improvements in specific social skills and overall social functioning were seen in some participants. We observed clinically-significant changes on specific subscales in all participants. However, trends in overall social skills changes were inconsistent across participants. Two participants showed overall improvement in social skills while one participant regressed in overall social skills. Another participant showed no significant change in overall social functioning.

Trends in the subscales of social functioning were also inconsistent. Two participants showed clinically-significant improvement in social communication while one showed a clinically-significant decline. One participant showed clinically-significant improvement in autistic mannerisms while another showed a clinically-significant decline. The same was true for social motivation. Only one participant showed clinically-significant improvement in social awareness, and one participant showed clinically-significant decline in social cognition.

However, trends in social skills changes were fairly consistent within participants. While participants 1 and 3 improved or remained constant in all social functioning measures, participant 4 declined in all social functioning measures. Participant 2 showed improvement in some but decline in others and did not have a clinically-significant change in overall social functioning. Perhaps different disabilities yield different responses to the classes. Further, the unique exercises may have led to improvements in certain social abilities, but declines in others.

Overall, results of this study do not consistently support an association between social improvement and participation. While this may be a result of methodological limitations (see *Limitations* below), it is consistent with the difficulty others have found in achieving clinically-significant
change in social functioning-based interventions (White, Koenig, & Scahill, 2007). Thus, future research should continue to explore ways that creative movement can be more consistently effective in addressing social difficulties.

**Qualitative Observations**

We learned a great deal about ways to promote creative movement. Designing the curriculum proved most difficult due to the diversity in disabilities. We took different approaches in designing free dance exercises. Sometimes instructions asking for verbal or drawn responses posed limitations for those participants who could not talk or hold a marker. Further, during the opening free dance exercises, some were still acclimating and appeared uncomfortable moving.

Non-free dance exercises were more structured and more varied to address the diversity of disabilities. They were far more successful than the free dance exercises. Overall, fewer instructions yielded more successful exercises. We even tried demonstrations to better communicate the instructions, but they did not make a difference. The children favored prop use, which appeared to help them focus on their movement. Children were sometimes uncomfortable with interacting with peers, and often only interacted with the adult volunteers. Though it did not facilitate development of peer-to-peer social skills, it did seem to facilitate interactions with non-familial or unfamiliar adults.

An effective tool we found was coming together in a circle when we were giving instructions. It provided a brief quiet period and an opportunity for participants to collect and regroup.

The design of this project was psychology and dance-based. We learned a great deal about integrating these two fields. Planning and implementing this project involved translating and communicating ideas unique to each field between each other. LMA, in its purest form, uses narrative analysis while psychology generally uses quantitative methods to evaluate data. We exerted ourselves to bridge this gap. Both sides benefited from borrowing a new approach to examine questions of interest.

**Limitations**

Some limitations in project design may affect the generalization of results to other dance classes. An overabundance of volunteers resulted in excess noise; some participants were sensitive to noise and refused to participate when it got loud. Crowding also sometimes prevented instructor visibility.

Data limitations existed. The study lasted five weeks with each participant attending four classes. The short duration may not have provided a sufficient “dose” to produce expected social function changes. The sample size meant the inability to make traditional statistical inferences. The lack of a no-treatment comparison group makes it difficult to conclude that the intervention caused the observed effects. The lack of follow-up assessment limits the ability to determine lasting interventional effects. We did not control or assess non-interventional conditions such as medication status or school environment. We also cannot generalize the data to other
populations or specific disabilities. Results came from one measure of social impairment, the SRS, which does not cover other aspects of social behavior such as ability to work with peers, friendship-making, and ability to empathize with peers. Also, the SRS’s language may not have been applicable to non-ASD children. Parents also only completed the measure at the beginning and end of the study; these two assessment points may not have provided enough insight on possible changes. The SRS also may not have been sensitive enough for evaluating the non-ASD children or for detecting subtle week-to-week changes.

Conclusion

The creative movement classes provided children with disabilities a unique opportunity to experience dance adapted to their abilities and to engage socially with peers who also had disabilities. We intended class themes to expose the children to a greater diversity of movement patterns. In some classroom settings, teachers and peers may not adequately engage ASD students because of their awkward social and emotional expressions, and peers may marginalize them (Burkhardt, 2007). Providing children with disabilities a venue for interacting with others without feeling socially rejected may be beneficial to their overall development and sense of self-efficacy. Additionally, the class provided families an opportunity for their child to participate in an activity, free of financial obligations. While our data did not show a clear association between class participation and social skills, it did show clinically-significant changes that suggest the possibility of a connection.

In addition to examining creative movement’s effects on social skills, we provided the community partner with some benefits. One benefit was that, since we led the class, the community partner could supervise and ensure the participants’ safety, as well as provide individualized corrections. We also gave her the opportunity to observe the children’s responses to the exercises, so she could observe how successful they were and then determine if she wanted to incorporate them in future classes.

Future Directions

We intend to analyze the LMA data quantitatively and qualitatively to assess possible changes in movement and to explore relationships between specific changes in movement quality and phrasing and social functioning. In order to investigate changes in movement quality, we will analyze the LMA Evaluation System data using both quantitative and qualitative methods. We will analyze data on a child-by-child basis because each has a different disability. We predict greater movement and phrasing variety will be apparent in deviations from the student’s baseline movement.

To investigate the relationship between movement quality and phrasing and social skills, we will analyze trends in each. Such analyses will be exploratory. We predict that trends in specific movement qualities may predict improvements in social skills (for example, we may see increased bound movement alongside a decrease in social motivation). These data may be
useful in creating a free movement-based evaluation system, with social implications, for the community partner.

References


### Biographies

**Casey Brown** is a fourth year Cognitive Science and Psychology double major at the University of Virginia.

**Amy Copeland** is a fourth year Biology major, Dance minor at the University of Virginia.

**Emily Lee** is a fourth year Biology major, Dance minor at the University of Virginia.

**Latasha Nadasdi** is a fourth year Psychology major, Sociology minor at the University of Virginia.

### Table 1

**SRS results**

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<th>Post-Program</th>
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<td>Overall</td>
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<td>severe</td>
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<th>Post-Program</th>
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<td>70*</td>
<td>moderate</td>
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</tr>
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<td>79*</td>
<td>severe</td>
</tr>
<tr>
<td>Overall</td>
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<td>77*</td>
<td>severe</td>
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<tr>
<td>Overall</td>
<td>70</td>
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<td>57*</td>
<td>normal</td>
</tr>
</tbody>
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Note. **SRS** = Social Responsiveness Scale. * = indicates clinically-significant change. T-scores $\geq 76$ = severe social impairment; 60-75 = mild to moderate social impairment; $\leq 59$ = normal functioning. A change in roughly 5 T-score points is considered a clinically significant difference.
Community-Led Sanitation in Simoonga, Zambia

By Caroline Berinyuy, Dillon Chapman, Hallie Eilerts, Marguerite McDaniel, and Emerson Prebil

Abstract

This paper describes a sustainable sanitation project conducted by University of Virginia students through the Jefferson Public Citizens program. The team partnered with village council members and local experts in the village of Simoonga, Zambia to design and build communal latrines and to create a village sanitation committee. The authors present the process of project development including topic, forming the student team, connecting with Zambian stakeholders and deciding with the community to build Ventilated Improved Pit latrines. The authors then describe community engagement in Simoonga and the construction process of two Ventilated Improved Pit latrines over six weeks. The paper concludes with a discussion of results, project challenges, village dynamics and lessons learned.

Introduction

Lack of proper sanitation is a worldwide health issue. UNICEF (2010) estimates that 2.6 billion people, constituting roughly 42 percent of the world’s population, lack basic sanitation. Only 36 percent of Sub-Saharan Africa’s population has access to hygienic sanitation while the other 64 percent suffers from unsafe and unsanitary conditions. Within the global context, hygienic sanitation is less accessible in Sub-Saharan Africa than in any other region in the world.

This project addresses the global sanitation issue at a local level with a community-led project in Simoonga. The village of Simoonga is a rapidly growing rural village of 1,500 people located approximately 20 km from Livingstone, a popular tourist destination in Southern Zambia. As their first step in addressing sanitation and community engagement, this group chose to utilize existing personal relationships and institutional opportunities, both within the classroom and through the Jefferson Public Citizens program, to foster a productive working relationship with Simoonga. This collaboration spanned two semesters of preparation and engagement and six weeks of implementation on the ground. The resulting sanitation project provides insight into the logistics of a sustainable approach to development, utilizing global resources and relationships for local, community-implemented solutions.
Methodology

Access to the Community

In the summer of 2006, prior to this team’s development, a future team member visited Simoonga and established contact with the managers of the Simoonga Village Project, an initiative of a prominent nearby tourist lodge. From that summer to early 2009, that team member maintained regular contact and interaction with the community. In early 2009, the team began to emerge through the creation of Supporters of Simoonga (SOS), a student organization that raised funds to improve access to schooling in and around the village. The team would soon attract students from various disciplines with an interest in development demonstrated through participation in several community development and engagement courses. Once the multi-disciplinary team was finalized, they saw an opportunity in further cultivating the relationship with Simoonga. This time, the team sought to work directly with community members on a project that combined the group’s drive and the community’s initiative and leadership. This project would recognize communal agency—that is, the community’s ability to address their own concerns and through that recognition, enhance the community’s capacity for harnessing productive potential.

The team first strengthened their existing relationship with Simoonga from abroad. From this established relationship, a community-led sanitation project began to evolve. In September 2009, Simoongan village leaders expressed a change in priorities to sanitation. The team shifted focus accordingly and worked to develop a project that would address this need. The team had extensive correspondence with a local resort which had a history of working in Simoonga and also connected with a Simoongan village council member by phone and email. Another point of contact was found in a local NGO which had been carrying out various health-related initiatives in Simoonga. The relationship with this particular NGO would prove to be instrumental in negotiating entrance to the community upon our arrival in Simoonga.

While strengthening relationships with partners abroad, the team also focused on developing local partnerships and strengthening internal connections among the members. One aspect of improving team dynamics was the pursuit of the design and construction of a prototype latrine with the assistance of Triple C Camp, a local summer camp in Charlottesville, VA. Due to differences in environments and community needs, the team built the latrine above ground, primarily from wood, and made modifications for efficient composting maintenance. Although designed differently than the ones to be built in Zambia, the prototype would not only help the team learn construction principles, but would also serve as the team’s foundation for discussing the project logistics with the community. It demonstrated the team’s commitment to the project and allowed them to come to the community meeting with the basis for working together with the community members.

Research of Design Alternatives

The team researched various latrine designs. They examined outside literature, including sanitation reports written by international institutions, global development organizations, state govern-
ments and other project teams (Kar & Chambers, 2008; Duncan, 1984; National Sanitation Task Team, 2002, Tilley et al., 2008). Criteria for evaluating effective possible solutions included building requirements, relative cost and upkeep requirements. The team, Simoongan village council members and representatives of the local NGO concluded that a Ventilated Improved Pit (VIP) latrine design was the most practical option for our purposes. The VIP toilet is comprised of a large pit and a structure above the pit. The structure consists of a sitting or squatting area, a vent pipe rising from the pit, and a fly screen above the vent pipe. Waste drops down into the pit, and organic materials are decomposed in the soil. The vent pipe reduces odors, and the wire mesh mounted on top of the pipe traps insects. The team and community selected the VIP design; it had the lowest estimated cost, was easy to implement and was most likely to be accepted by the community since variants of the design were in use at the local school.

**Engagement on the Ground**

The team envisioned a flexible project capable of embracing the distinct perspectives of the village council, local experts, community members and other Zambian groups. The project was structured to welcome all forms of participation and leadership from all community members, with a concentrated effort to reach marginalized residents who typically lack the opportunity to contribute in community activities. The team also respected the fact that some individuals did not wish to participate in the project.

During the preparation stage, the team built connections with Simoonga in an indirect manner, approaching local individuals and NGOs already partnered with the initiative. After arriving in the village and throughout the project, however, the team emphasized community-wide participation to engage as many of the villagers as possible. One hundred eight villagers attended the first meeting, which was open to all those interested and able, to participate in planning the project. The team introduced themselves as enthusiastic yet inexperienced students, ready for the community to take the lead and make the project their own. The team also gave printed packets to the village council further detailing the project and the team members. The team presented the basis for the project and a proposed design for the permanent VIP latrine structures. An open discussion of the project followed; the team took notes on the discussion as community members became increasingly comfortable in sharing their ideas about the design and project in general. This first meeting was a necessary first step in fostering the community’s sense of ownership toward the project.

Technical experts including bricklayers, carpenters and individuals with other construction experience took the lead of day to
day activities on the ground. The team also welcomed workers with little to no background in construction, who gained valuable work experience through the process. The team emphasized that any donation of time and labor on behalf of the experts was not obligatory and only appropriate when it did not interfere with their livelihood. As part of the team’s contribution to the process, the workers would receive a free lunch, a certificate to present to potential employers as part of their resumes and the satisfaction of contributing to the development of their own community. Using food purchased with project funds, women of the village cooked the workers’ lunch. This practice ensured that whether or not women participated in the physical construction of the latrines, they were still invested in the project process. With this volunteer based system established, the project could be sustained by the existing expertise and human capital of community members.

Construction

While there were some slight differences between the two VIP latrines constructed in Simoonga, the building process was essentially the same for each latrine. First, a pit had to be dug; the sandy soil made digging relatively easy but also contributed to a high number of wall collapses. The villagers originally planned to dig a distance of three meters for a greater pit volume, but as collapses became more frequent, the pits were instead dug between 2 and 2.5 meters deep. Once community and team members dug and cleared out the pit, they built the latrine’s bottom slab, which provided support to the bottom walls of the structure, and left it to set. The team then built the bottom walls of the structure on top of this slab using layers of concrete blocks and mortar made from cement, river and pit sand, and water.

The team built a floating concrete slab upon the structure walls. Workers used concrete blocks to create holes in the slab, around which they later positioned additional concrete blocks to create two toilet holes and seats. In a manner similar to the bottom walls, the team built the structure’s top walls, including a wall dividing the structure into two stalls. Holes were carved out of the top slab and ventilation pipes were placed in these holes. Wire mesh on the top of the ventilation pipes prevented flies from traveling out from the pit and potentially spreading disease from the waste. Workers placed wooden planks along the top of the structure, then tied iron sheets on top of these wooden planks. A local carpenter built wooden door frames and doors, which the team set into the structure. The team painted the structure and doors, backfilled the hole with rocks, and leveled the area with sand. Workers painted the latrine’s date of completion and “Built by the People of Simoonga” in English on the first latrine and in siLosi, the most common local language, on the second latrine. This message was particularly important to the team and the villagers, as it embodied the villagers’ pride and sense of ownership of the structures.

Upon completion of the first latrine, the team called another open meeting so that members of the community could assess the structure. The second latrine incorporated all the suggestions of community members, a reflection of the continued dialogue with the community.
Perspectives

Simoonga had previous experience with development projects, but these were of a different nature than previous community-led sanitation. Nearby tourist lodges have sponsored several new buildings for the community, including a community hall, police post, medical clinic and water generator station. These buildings are constructed by paid professionals from the nearby city, an approach that increases construction efficiency but prevents community ownership. For instance, the roof of the community hall which had been built by a tourist lodge in 2009 was damaged, but the villagers refused to fix it because they believed that the lodge would also handle maintenance.

Past projects in Simoonga had thus failed to address sustainability and provided results that were quantifiable, yet inherently short-term solutions. Examples of such projects and their lackluster results reinforced the team’s conviction to prioritize engagement over efficiency. In focusing on the nature of the team’s relationship with the community and the community’s relationship with the construction process, the quantity of latrines constructed became less important. While the team had hoped to build more than two latrines, they also recognized that the quantity of structures mattered less than the general acceptance and ownership of the project by the local community.

The nature of this project did not easily lend itself to quantifiable metrics of success, aside from the fact that two latrines were fully constructed in the village. It was not possible to test our research question by, for example, building different designs of toilets and determining which was preferred; this would have been expensive, time-consuming and unproductive. However, the success of the project could be qualitatively assessed. One measure is the team’s strong relationships with the village council, the local builders, the village as a whole and outside government agencies and groups. The team collaborated with these stakeholders to create the most optimal latrine for the village and to ensure that the community provided the drive behind the project. The message “Built by the People of Simoonga” painted on the latrines symbolizes this open dialogue and community engagement.

The project’s success can also be assessed by its sustainability, which is most clearly embodied by the community sanitation committee created by the village and team. The sanitation committee is a coalition of male and female villagers, including many prominent contributors to the project. The committee, which continues to meet regularly, organizes maintenance of the latrines and promotes improved sanitation practices through education and awareness of sanitation issues, encouraging use of the latrines, and raising funds and support for more latrines.

While the sanitation committee stands out as the team’s most positive impact on sanitation in Simoonga, the team had to overcome several challenges to achieve that success. The team discovered the limits of communication and understanding when devoid of context. Dialogue with community partners prior to arrival in Simoonga generated a set of assumptions about the village, how they would be received and how the project would be carried out. Where the team
expected to find a village which shared a common history and sense of community, they instead found a collection of individuals coming together under varying circumstances, ultimately for reasons of convenience.

Upon arrival in Simoonga, one must immediately choose to turn right, left, or continue straight. The neutral choice of continuing straight leads past the community hall to Simoonga Basic School at the end of the road, where children from both sides of the village come together to learn. Essentially bisecting the village, this road held much greater significance in Simoonga than originally perceived. The road divided the village as the headman’s territory to the left and the headwoman’s territory to the right, a tangible realization of the social, political and economic rift between the two areas. In the middle, attempting to bridge this village gap was a nascent, year-old village council. An organization which the team had thought to be well-established was in actuality struggling to define its role and demonstrate its effectiveness as it straddled this division. The team was not initially aware of issues such as the village split or the newness of the village council structure and the limits of long distance communication were increasingly revealed throughout the team’s time in the village. Inequalities and tensions between the two sides and the weaknesses of the governing structure became more salient as time drew on. Although the community division was discouraging, the school provided an excellent demonstration of the potential of all parties in Simoonga to work together. It was the team’s goal to help Simoonga realize this existing potential and translate it into action.

Finances for this project became a significant issue. For the team’s part, they lacked knowledge of local building material prices and thus underestimated material costs; they also mistakenly overbought materials for the first latrine. For the village’s part, Simoongans had been used to working with partners with large budgets who prioritized efficiency over collaborative decision-making. The lodges used payment as an incentive for labor rather than the community engagement approach of inspiring villagers to work to benefit their community. It took open communication and several meetings to challenge the preexisting mindset of valuing financial capital over human capital.

**Conclusion**

As stated above, the divisions existing in the village and the effects of previous exterior projects created complicated dynamics within the village. The team acknowledged that these complexities were not to be taken lightly. During preparation the team recognized that conditions on the ground would change, necessitating flexibility in all aspects of planning. The team’s prolonged time on the ground allowed them to learn as much as possible about all relevant forces so that all stakeholders agreed upon the project and considered it relevant to their unique circumstances. While more latrines would have been more impressive, the team needed time to build relationships so that the constructed latrines would be embraced by the community. Taking the time to engage people in communication and build relationships among community members as well as team members is important in working with partners both locally and internationally.
References


Biographies

Caroline Berinyuy is a PhD student at the Curry School of Education specializing in Comparative and International Education.

Dillon Chapman is a fourth year student majoring in both French and Spanish who will work with Teach For America after graduation.

Marguerite McDaniel is a fourth year student majoring in Mechanical Engineering who is interested in pursuing a career in the global energy sector.

Hallie Eilerts is a third year student majoring in both Global Development Studies and History who has no idea what she wants to do after she graduates, but is excited to figure it out!

Emerson Prebil is a fourth year student majoring in Systems Engineering and minoring in History who is considering a career as an analyst or consultant.
Curriculum and Materials Development for the Elizabeth River’s Learning Barge

By Rachel Baker, Carla Jones, and Haley Pack

Abstract

The Elizabeth River Project and the University of Virginia’s Schools of Architecture and Engineering collaborated to create the Learning Barge, a teaching vessel used to educate K-12 students about environmental stewardship. At the request of Learning Barge staff our team focused on developing resources for the wetlands station which uses a living wetland to teach students about the ecosystem services of wetlands. Specifically, we directed our attention to wetland reconstruction, curriculum development and seining pool uses. We explored why the wetlands weren’t functioning properly and used matrices to evaluate three proposed curriculum tools and three proposed uses for the seining pool. We provided a detailed plan for repair of the wetlands, suggested that a turbidity tube and student activities be used to enhance the curriculum at the wetlands station and proposed placing wetland filtration demonstration boards in the seining pool.

Introduction

The Elizabeth River in Portsmouth, Virginia has suffered from centuries of abuse and neglect. After the Norfolk Naval Shipyard was established in the 1700s and the river was dredged substantially in the 1800s, the river’s health decreased drastically (Elizabeth River Project, 2010). Increased industrialization along the river led to extensive contamination by harmful bacteria from sewage such as fecal coliform, and creosote pollution and tributyltin toxins released from a wood treatment facility (Elizabeth River Project, 2008). This contamination has resulted in health problems for humans and very high cancer rates in fish while also rendering the water “unswimmable” (Elizabeth River Project, 2008). The river is also considered “unfishable,” resulting in a ban on oyster harvesting that still stands today. Sediment contamination is 1,000 times the average for the Chesapeake Bay and half of the rivers’ wetlands have been lost (Elizabeth River Project 2008).

The Elizabeth River Project (ERP) has made it their mission to educate students about the Elizabeth River and to make the river “fishable and swimmable” by 2020 (Elizabeth River Project, 2010). In 2009, The University of Virginia’s Schools of Engineering and Architecture collaborated with the ERP by developing a unique teaching tool, the Learning Barge.
The Learning Barge

The Learning Barge, “the world’s first floating wetland classroom,” teaches students about the Elizabeth River and also serves as a model of sustainability. It generates its power from photovoltaic solar panels and wind turbines, is equipped with composting toilets and utilizes a rainwater collection system with on-board wetlands to filter saltwater and graywater (Elizabeth River Project, 2009). The barge affords students a great opportunity for experiential learning while also incorporating Virginia Standards of Learning requirements.

Focusing on the Wetlands Station

From the start, the goal of our project was to support the mission of the Learning Barge and the Elizabeth River Project. To understand how we could best accomplish this goal we met with Learning Barge staff members who discussed several areas they considered weaknesses in their current operation and tailored our work to meet the needs expressed by these educators who interact with the students on a daily basis.

First, the educators saw potential for improvement in the wetlands. The on-board wetlands were not functioning as natural wetlands do. Determining why these wetlands were not working and proposing a plan for their improvement was one of our goals.

Second, the staff wanted us to add to the curriculum at the wetlands station by developing a new hands-on activity for the students which would involve using instrumentation. They were dissatisfied with their current activity in which the educator used a secchi disk—a wooden disk with black and white markings—to assess turbidity. In this activity, the educator lowered the disc into the water until it was no longer visible from the surface, recorded this depth, raised the disc back up until the markings were visible again and recorded this second depth. The turbidity of the water was then determined using these two depths. Because the ERP staff thought it was unsafe for children to lean over the edge of the barge to use this tool, no students carried out the sampling. The Learning Barge educators wanted to get students
actively involved in the station by giving students their own tools to measure water quality.

Third, the staff requested that we develop a use for the shallow seining pool surrounding the wetlands. The seining pool is intended to hold water from the wetland basins before it is released back into the river. Though the seining pool is a large space with potential for constructive use, when our project started it only contained empty oyster shells. This space provided a great opportunity to educate the students on the aquatic life of wetlands and how wetlands function.

**In summary, the three main problems our project aimed to address were:**

1. Limited functioning of on-board wetlands
2. Lack of appropriate tool use and curriculum for student involvement at Wetlands Station
3. Underdeveloped use of the seining pool

**Methods**

*Wetland Reconstruction*

One of the most innovative aspects of the Learning Barge is the on-board wetlands. There are three series of long, narrow wetland basins on board which contain native wetland plants. There are both saltwater and freshwater wetlands, which serve the purpose of filtering graywater from the barge's bathroom sinks and water from the river, theoretically cleaning it before it is released back into the river. Wetlands serve a number of very important ecosystem services: functioning as animal habitats, breeding areas, nurseries and food sources; sediment retention; flood and erosion prevention; temperature moderation; ecosystem health indication; and water filtration. The goal was for these wetlands to function as natural wetlands, illustrating to students what they do in nature, and why they are so important. However, the on-board wetlands did not function properly in filtering water and we researched solutions to improve their effectiveness. We gathered information from relevant classroom experiences and lectures, artificial wetland construction literature, design reports from Learning Barge engineers and a first-hand assessment of the wetlands. In brainstorming solutions, the team took into account the feasibility of changes to the already completed and constructed wetlands on-board the Learning Barge and the goal of having on-board wetlands that were highly effective at cleaning river water.

*Curriculum Development*

We addressed the need for a new curriculum by researching artificial and natural wetlands and integrating this information into lesson plans. We suggested revisions to the curriculum and then incorporated these revisions into the script used by the Learning Barge staff.

We also assessed various options for scientific tool use. We compared secchi discs to chemistry test kits, turbidity tubes and a water quality probe and formulated a matrix to assess each option. This matrix presented desired qualities in a teaching tool and compared the number of criteria each tool met.
Table 1. Wetlands station tool matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Secchi Disk</th>
<th>Chemistry Kit</th>
<th>Turbidity Tube</th>
<th>Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Ease of use.</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B. Cost-effective</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>C. Student-to-tool ratio</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>D. Ability to acquire local materials</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>E. Environmentally friendly</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>F. Satisfies ERP’s needs and desires</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>G. Relevant to current station</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>H. Interesting to students</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>I. Fits well into station time-constraints</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>J. Durable</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>K. Does not require energy</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
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<td>10</td>
<td>3</td>
<td>10</td>
<td>3</td>
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</tbody>
</table>

Seining Pool Use

Our third and final task was to develop uses for the underutilized seining pool. After much research, we developed three proposed uses for the seining pool that were both feasible and educational.

The first was to construct two sloped wetland filtration demonstration boards, one with turf on the surface and one without. Turbid water would be pumped to the top of each 4-foot long plywood board using a solar pump designed by UVA engineering students. The water would then trickle down each board into separate glass tanks. The students would be able see the filtration capabilities of vegetation by comparing the cleanliness of the water. The water in the tank beneath the turf-covered board would be substantially cleaner than the water in the tank beneath the bare board. This activity would fit well with the curriculum for the wetlands station, which is next to the seining pool.

The second proposal involved construction of visible wetlands. The visible wetlands would be smaller versions of the current wetland basins and would be housed in clear tanks. These wetlands would make a wetland cross-section visible to students. Our proposal involved two clear aquarium style tanks placed near the already existing wetlands. This option would allow students to see the strata of a wetland and observe the plant roots and sediment. By allowing students to see the strata and having a model for the deckhand educator to explain, students would better understand how wetlands function.

The final proposal was a wetland touch tank that would be built inside the seining pool and contain animals native to the wetlands of the Elizabeth River such as minnows, horseshoe crabs, worms, snails, crayfish and hermit crabs. These animals were chosen because they do not pose a danger to the students and are easy to maintain. The purpose of the touch tank was for the stu-


dents to learn about the animals that are native to the wetlands of Virginia. This activity would have a clear connection to the next station, which talks about animals of the river.

In order to determine which proposal was best suited for the seining pool, we developed a matrix similar to that used for the wetland activity. Additionally, we researched the specific materials needed for each proposal and carried out a cost-benefit analysis.

Table 2. Seining pool proposal matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Wetlands Filtration Demonstration</th>
<th>Visible Wetlands</th>
<th>Wetlands Touch Tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Easily built</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B. Cost-effective to build</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C. Use of local materials</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>D. Use of native resources</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>E. Environmentally friendly (i.e., use of recycled and/or recyclable materials)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Classroom Use:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Relevant to current station focuses</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B. Interesting to students</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C. Fits well into station time-constraints</td>
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<td>1</td>
<td>1</td>
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<td>Practicality:</td>
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<tr>
<td>Easily maintained</td>
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<td>1</td>
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</tr>
<tr>
<td>Aesthetically pleasing</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Usable in all seasons</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Durable</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Self sufficiency</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Economically sustainable</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Environmental friendly</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>12</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>

Results

Wetland Reconstruction Proposal

To transform the wetland basins into a functioning system, we made an in-depth proposal to assess potential problems in the wetlands and suggested alterations. First, we suggested that holes be drilled in the bottom of the basins. The input and output holes were both on the top of the wetland, which only encouraged surface flow, rather than the vertical and subsurface flow that is necessary for most of the filtration. Additionally, we thought that soil in the basin should be replaced with a different size substrate, preferably small gravel of 0.5-1.5 mm, with larger gravel of 2-4 cm around the edges (Trama, 2009). Improvements to the plant communi-
ties were suggested, both in density and species diversity. A much larger diversity of plants was needed as well as a greater number of plants since there should be 52 plants per square meter (Capers & Les, 2005), and 11.2-14.5 different species per square meter (Anderson & Leopold, 2002). There was no goal for water quality upon output from the system, nor was there any water monitoring being done to quantitatively assess the wetland functioning. These two concepts are critically important in ensuring that the wetlands function properly.

We recommended setting goals and implementing several measures to assess the filtration abilities of these wetlands including performing water testing before and after water travels through the basins and using fluorescein dye to assess flow rate and calculate the retention time necessary for appreciable water quality improvement. Additionally, we thought microbe levels should be tested and that microorganisms should be introduced if necessary. Microorganisms present in the sediment are a pivotal part of the natural water filtration process as they break down toxic substances. Additionally, we suggested that specific guidelines for the wetland basins be established including obtaining plants, their removal in the cold off-season months and potential periodic planting of the wetland grasses in the river to aid in restoration efforts.

Curriculum Development Proposal

As part of the curriculum development, we provided several potential demonstrations to display ecosystem services for different student age levels. In one activity we suggested, students would learn the importance of wetlands in protecting species by acting as the predator and picking up objects first from a simulated grassy wetland habitat and then from a bare habitat. Students would have equal time to pick up objects from both habitats and would see how the vegetation of wetlands protects prey since they would gather more prey objects from the bare area than from the simulated wetland habitat.

Another piece of the curriculum development was the selection of an instrument for students to use at the station. After assessing each tool, the turbidity tube was determined to be the best option and was the tool we recommended. Its various positive aspects included ease of use, cost effectiveness, good student-tool ratio, satisfaction of ERP’s expressed desires, relevance to the station, ease of fitting into lesson time constraints and durability. A turbidity tube is a plastic tube with a disk at the bottom and centimeter measurements written on the side. The disk is painted black and white to allow students to clearly distinguish it. To use the turbidity tube, students pour water in the tube and stop adding water when they can no longer see the disk. Then, students record the water level in centimeters and substitute this measurement into an equation to determine the turbidity of the river water (Myer & Shaw, 2006).

Seining Pool Use Proposal

The matrix tool was helpful in determining the appropriate use for the seining pool. The high cost and relative difficulty of implementing and maintaining the touch tank was the reason this
proposal garnered the fewest points in our matrix. The relative complexity and upkeep required for the visible wetlands rendered them the second most effective choice compared to the simple, durable and inexpensive demonstration boards. Therefore, we deemed the wetland filtration demonstration to be the most effective use of the seining pool, but we shared all options and selection criteria with the ERP.

**Discussion**

We faced many challenges throughout the process of completing this project. Two members of the original team decided to pursue other interests and our team had to be reconstituted and reevaluate the project focus. In addition, we had a difficult time communicating with our community partner. The ERP was very busy with constant Learning Barge tours and had limited staff time to work with us. However, we did our best to design possible resolutions to the problems that Learning Barge educators expressed. In the future, agreeing upon expectations and set meeting dates and times at the onset of the project may be helpful in facilitating better communication. Creating a contract between the community partner and our team would have been one way of ensuring that everyone involved was clear on the project’s goals, methods and desired outcomes.

Now that we have developed potential solutions to the problems identified by our community partner—the Elizabeth River Project—and shared these solutions with them, we will be receiving feedback on which solutions they want us to implement and will move forward in all three areas of our project: wetlands reconfiguration, wetlands curriculum and the seining pool. The next steps for wetland reconfiguration may be to re-plant the wetlands, change the soil composition or drill holes in the current structure. For wetlands curriculum, our next actions could involve building turbidity tubes to supply to the Learning Barge for classroom use and finalizing and printing scripts for the wetland station. For the seining pool, we plan to build a prototype of the option the ERP chooses and use this prototype for assessment and alterations before large-scale implementation. It is our hope that our research and proposals will prove useful to the Elizabeth River Project and enhance the learning experience of students who visit the Learning Barge.

**Biographies**

**Rachel Baker** is a 2010 graduate who studied Environmental Sciences and Biology. She is attending Duke’s Nicholas School of the Environment, working towards a Masters of Environmental Management and a Masters of Forestry.

**Carla Jones** is a 2010 graduate who studied Urban and Environmental Planning. She is currently pursuing a Masters of Urban and Environmental Planning at UVA.

**Haley Pack** is a fourth year Environmental Thought and Practice major. She plans to pursue a career in environmental science or environmental planning.
References


Composting In Bluefields, Nicaragua

By Robin Kendall, Benjamin Robbins, Auesta Safi, Rowan Sprague, and Ania Turnier

Abstract
This Jefferson Public Citizen’s (JPC) grant continued a previous University of Virginia JPC research project, which identified a need for the sustainable use of discarded organic materials. The current team researched an effective, sustainable composting model to create an education and implementation campaign throughout the city of Bluefields, Nicaragua. The composting model was formulated through key informant interviews, soil testing and site visits. The site visits were made to the municipal governments composting site, a sustainable agricultural farm, the Bluefields Indian and Caribbean University farm and the Coprash, a youth rehabilitation center. From the information gathered, the education and implementation campaigns took many forms including: presentations to Bluefields high school students; a composting door-to-door education campaign; a mural in the central park; a public service radio announcement; and a t-shirt endorsing ‘Throw away trash, separate waste, and compost’. This work heightened awareness of the detrimental environmental effects to burning organic waste and increased appreciation for household composting.

Introduction and Background
In the summer of 2009, five University of Virginia students were awarded a Jefferson Public Citizen’s grant to research the feasibility of community businesses in Bluefields, Nicaragua. After a month of research and interviews, the students found three potentially viable community projects: a water filter production facility; a more efficient biogas system; and a sustainable composting project. The following year, a new team of five was awarded a second Jefferson Public Citizen’s grant to research an effective, sustainable composting model for the Southern Atlantic Autonomous Region (R.A.A.S) of Nicaragua while implementing this model in the city of Bluefields (the capital of the R.A.A.S). Nicaragua is the second poorest country in the Western Hemisphere (U.S. Department of State, 2011). Approximately one third of the country’s Gross Domestic Product is derived from agriculture, timber and fishing (U.S. Department of State, 2011).

Key informant interviews conducted by the 2009 JPC team identified composting and a need for alternative waste practices at the local Bluefields dump to improve sanitation problems. It was found that roughly 75% of the waste that was delivered to Bluefields’ open-air dump was organic (G. Bravo, personal interview, June 13, 2009). All of the waste, both organic and inorganic, was burned while additional waste was added to the dump, creating a continual burning cycle. The goal of this JPC grant was to learn effective practice methods for composting and use this knowledge to increase both awareness and the practice of effective composting in the city.
Composting is a method for the disposal and reuse of organic waste materials, in lieu of burning waste. Compost consists of a balance of carbon and nitrogen rich organic materials layered on top of each other (Smith et. al, 2010). The carbon materials are more fibrous and take longer to degrade, and include leaves, small branches and wood chips. The nitrogen materials are fresher and take less time to degrade, and include grass clippings, fruit and vegetable waste (US Environmental Protection Agency, 2008). Combined, the carbon and nitrogen materials mix to create a nutrient rich soil. Compost creates fertile soil as a sustainable use of organic waste, which can be used in agriculture and horticulture.

**Methods and Approach**

The project was divided into two components: (1) a quantitative research approach in which nutrient levels of different compost were researched by testing soil samples; (2) a participatory action model in which key stakeholders were interviewed to learn about the composting and effective ways to implement an educational campaign.

To develop and disseminate the best practice models, the natural first step was the assessment of current models. For the quantitative data collection, soil samples of compost piles from various sites in Bluefields were tested. The samples were taken from four main compost sites: the local dump made by the Alcaldía’s Office of the Environmental; FUNCOS, a sustainable agriculture farm; the Coprash, a rehabilitation center for youth; and the demonstration farm of the Bluefields Indian & Caribbean University (BICU). The samples were tested for their pH, phosphorus, nitrogen and potassium levels using a LaMotte Soil Testing kit. The soil samples were tested for these levels because they are characteristically used when comparing compost (Watson, 2010). The nutrient levels were not listed numerically but were assigned categories of “Trace, Low, Medium, High, and Very High” based on the color changes of the tests. The tests involved adding nontoxic chemicals to small amounts of soil mixed with purified water, and the results were recorded. After collecting this data, the nutrient health of the compost from the soil test sites was compared quantitatively. These results determined which composting method produced the highest quality compost.

After the quantitative data was obtained, a participatory action model was used to facilitate the development and implementation of the educational awareness campaign. This model was based on interviews with key informants, as well as site visits. Community members involved in creating and maintaining the compost were interviewed to determine which composting method should be promoted and how the information should be disseminated. These key informants included members of the Alcaldía’s Office of the Environment, an environmental science professor at BICU and members of the Bluefields Scouts. These informants were also questioned about different environmental concerns and initiatives happening in Bluefields, as well as recommendations they had for engaging the Bluefields citizens. From multiple composting site visits and key stakeholders’ recommendations, several different methods for involving the people of Bluefields with the project were decided upon as a way to advocate environmental awareness and household composting.
It was decided that the best education approach would be through engaging the youth. The Scouts helped obtain permission to allow high school students to attend both a presentation regarding environmental awareness and a door-to-door educational awareness campaign. JENH-CEDEHCA, a youth nonprofit organization, and the Alcaldía’s Office aided the JPC team in establishing the content of the campaign, targeted locations and how to market the message most effectively with the widest distribution.

The door-to-door educational awareness campaign was chosen to take place at the Santa Rosa barrio because it was the largest neighborhood in the city of Bluefields and constituted a region with notable waste disposal malpractices. During the day of the campaign, flyers were distributed to the high school students who then circulated the flyers to the residents of Santa Rosa. The flyers summarized important information learned by the team through its interaction with key stakeholders and site visits: the steps of composting and its benefits.

Results

The results of the JPC composting team’s work was again divided into two components: (1) the outcome and analysis of the nutrient levels of the different compost soil samples; and (2) the participatory action campaign results regarding community engagement and composting awareness. The component of the project concerning the quantitative research is summarized in Table 1 below.

Table 1: Nutrient information of the four soil tests performed

<table>
<thead>
<tr>
<th>Sample Area</th>
<th>Soil pH</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Potassium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcaldía</td>
<td>8.0</td>
<td>High</td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td>FUNCOS (Vermaculture)</td>
<td>7.0</td>
<td>Low</td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td>Coprash</td>
<td>5.0</td>
<td>Trace</td>
<td>Trace</td>
<td>Medium-Low</td>
</tr>
<tr>
<td>BICU Farm (Vermaculture)</td>
<td>7.0</td>
<td>High</td>
<td>High</td>
<td>Very High</td>
</tr>
</tbody>
</table>

The compost from the Alcaldía compost site and the compost from the BICU demonstration farm had the highest nutrient levels, while the compost from the Coprash site had the poorest. Low values of nitrogen, phosphorus and potassium were found to indicate that the compost was not very fertile (Watson, 2010). A typical level of pH was researched to be around 6.8-7.3. The compost from the Alcaldía compost site and the compost from the BICU demonstration farm had appropriate pH levels, indicating a proper acid-base balance. The high levels of nitrogen, phosphorus and potassium indicated that their compost was very nutrient rich and fertile. The compost from the FUNCOS site had relatively fertile compost with the exception of its nitrogen levels, which were low. The Coprash site had basic soil with a pH level of 5 containing low values of all measured soil nutrients.

The community based participatory action included a presentation to 250 secondary school students concerning environmental awareness and composting; an environmental “campaign day” in Santa Rosa with the aforementioned students; creating a mural in the city park with a local
artist and an after school youth organization; a radio public service announcement with the Scouts about composting and its benefits; and a t-shirt about composting and respecting the environment.

The group formed three main educational pillars for the teaching campaigns, based off the interviews with the Alcaldía’s Office of the Environment. The group presented these points at the high school demonstration, reminding them that these points would be the same presented to Santa Rosa residents during the door-to-door awareness campaign. The pillars were as follows:

1. Throw trash into a waste receptacle.
2. Separate garbage into organic and inorganic waste.
3. Compost organic waste.

The presentation to local high school students covered the steps of how to compost at home. Students were split into groups to participate in small activities and practice their door-to-door conversations for the educational awareness campaign. At the end of the presentation, the JPC group handed out bags of compost. On these bags were written the date, time and location of the campaign, to remind the students and provide them with a working example of effective compost for their home. As a part of the educational door-to-door campaign, the team designed and printed t-shirts that promoted the three-step message of household composting. These shirts were then given to the students before the start of the campaign and emphasized the team’s composting message even more.

When the students arrived, they formed groups according to their secondary school. Each group was chaperoned by a teacher or a Scout member to act as a guide and covered a different section of the Santa Rosa barrio. The students were self-motivated and engaged with their fellow Bluefields residents. Overall, the outcome of the door-to-door composting awareness campaign was a success. The JPC team saw local high school students engaging with residents of the Santa Rosa neighborhood and explaining the three-step message the students had been taught days before at the High School presentation.

In addition, the group endorsed composting through a mural at a local park. JENH-CEDEHCA helped establish contact with the aforementioned after school youth organization. One of the leaders of this organization was a local artist whose murals were displayed in numerous locations
in Bluefields and featured images appreciating ethnic diversity and unity, as well as encouraging education. By collaborating with this after school youth organization, a mural endorsing composting was created under the direction and artistry of the leader and the help of 15 students. This mural is now seen daily by anyone who passes through the park in the center of the city.

Lastly, the public service radio announcement that was made in collaboration with the Alcaldía’s Office, Radio La Costeñísima and the Scouts was played on the air on numerous occasions containing the three-step environmental message and composting instructions to reach a greater number of people in Bluefields and the surrounding areas.

Discussion and Conclusion

This JPC team’s goals were to research and implement a sustainable composting program in Bluefields using best practice research from the local community to encourage more sustainable and healthy waste disposal practices. The group’s results from the soil testing had a lasting and beneficial impact on the Bluefields community, since the organizations this team partnered with were committed to using best practice methods. Composting was seen as a way to mitigate potential environmental damage and improve the wellbeing of each household.

Objectives

This team’s first goal was to research and implement sustainable composting through three steps: (A) research best practices of local composting methods; (B) research local household waste disposal practices so as to better understand the impact a composting program would have at the household level; and (C) increase the awareness of and access to composting information. In order to realize the success of each of these three steps, the nutrient quality of several regional composting sites were examined by the group. Soil samples were collected and analyzed, and this analysis allowed this JPC team to determine which organizations had the best composting methodology (as defined by pH level and nutrient content). As discussed above, it was determined that the compost at both BICU and the Alcaldía’s Office was the best compost that suited the region’s geo-specific needs. With further research into the methodology of creating the best compost, this JPC team was able to prepare instructions for household composting and initiate multiple composting awareness campaigns.

Implications

The information gathered in this group’s first goal to research and implement a sustainable composting program in Bluefields facilitated the delivery of this research to the local community to encourage more sustainable and healthy waste disposal practices and mitigate potential negative effects resulting from poor waste disposal. In partnership with several local organizations, this team was able to research the best composting method and increase community awareness of this composting method and its benefits. A household campaign enacted by the student volunteers informed Bluefields residents of sustainable waste disposal and composting practices.
This campaign served as a way to potentially mitigate several potential problems associated with the local environment and quality of life, and these benefits to the community will be discussed in detail below.

**Limitations**

While this project held many beneficial implications for the Bluefield community, this project did have two notable limitations. First, a model household compost pile was not constructed by the JPC team due to time constraints, complications with the local weather and land use issues. This model would have provided a contextual demonstration of the setup and maintenance of composting for Bluefields residents, bringing the conceptual ideas of the educational campaign to life. Although the JPC team did not have the time to create this model, the compost pile designs and soil testing kit were left with the local university so that they may build and test their compost. The second limitation of this project was that the JPC team did not work as closely with the community members at the compost site visits as the team had originally hoped and planned. The team would have liked to present their findings of the different composting methods to all of the community members who had compost, as this presentation would have facilitated collaboration between these community members and would have led to more sustainable and healthy composting practices. While the JPC team did present their findings to three of the community members who had compost, they did not present to all community members.

**Impact**

Despite the aforementioned limitations, the JPC team realized several successes surrounding the team’s main goals of researching an effective composting method and promoting this method through a social marketing campaign aimed at local households. This campaign delivered composting information that impacted life at the household and communal levels. At the household level, developed composting practices had two effects: (1) composting acted as a natural fertilizer for homegrown vegetable gardens, and (2) composting helped reduce unhealthy waste disposal practices, such as high levels of waste delivered to the municipal dump and the subsequent burning of inorganic waste. At the communal level, developed composting practices and the subsequent household campaign had two major effects: (1) the campaign raised awareness about the safety and health of the Bluefields Bay – a source of considerable commerce and subsequent income for the local community; and (2) the campaign facilitated the dissemination of composting knowledge throughout the community, which contributed significantly to the development of effective composting methods to local community organizations that utilized the method, notably the Alcaldía’s Office and the Coprash. Therefore, at both the household and communal levels, increased awareness of composting and its related benefits worked to create lasting improvements to the well-being and health of the Bluefields community.
References


Biographies

Robin Kendall is a fourth year Global Development Studies and Commerce double major with a concentration in Finance. This is her second Jefferson Public Citizen’s grant and her fourth research project in Bluefields, Nicaragua.

Benjamin Robbins is a third year Commerce major from Branford, Connecticut concentrating in Marketing and Informational Technology with a minor in Leadership.

Auesta Safi is a third year Chemical Engineering major from Sterling, Virginia and is interested in alternate and sustainable energy.

Rowan Sprague is a second year Civil and Environmental Engineer from Richmond, Virginia and is interested in sustainable systems and global cultures.

Ania Turnier is a second year pre-Commerce student from Port-au-Prince, Haiti. She hopes to ultimately go back home and contribute to the economic development of her country.
Active Engagement:
Building sustainable stoves and relationships in Mashamba, South Africa

By Katelyn Mason, Anne de Chastonay, Anne Rasmussen, Matthew Baer, Jessica Rothbart, Deanna Vogt, and Carol Anne Spreen

Abstract
Project ECOvision is a community engagement project with the Mashamba community in South Africa that began in the fall of 2008. An interdisciplinary team of UVA students and faculty collaborated with the community to develop a more efficient cooking method for a primary school that uses only local materials which would also serve as an education tool. The success of this project was based on the level of community involvement and ownership over the project as well as the team’s openness about the project and willingness to actively engage with the community. Living with the teachers in the community and understanding their culture proved to be a successful avenue of active engagement that opened lines of communication with many stakeholders that helped to mobilize local resources for the stove. The trust and confidence that the teachers developed in the group aided in the communication with skeptical members and helped the group work within the hierarchy of the community. The sustainability of this project came through collaboration with the local experts in bricklaying and metal work that were able to complete another stove after the group left the community. As with most community based projects, there were certain limitations on the work that could be done. Time was a big constraint on our project as were the cultural and language barriers. Overall, though, this project was a success in actively engaging the community and mobilizing resources to create a sustainable initiative.

Introduction
Most university-based community service learning projects focus their efforts on improving conditions in communities. While different initiatives emphasize different approaches in defining the scope and terms of a project, these activities do not necessarily determine a project’s success. In this article, we suggest that “success” can be ensured through “active community engagement” that not only informs and asks members for their input and approval, but also centrally involves them in design, construction and learning about the project. Carefully considering in advance and continuing to strengthen communication, involvement and relationships between the research team and the local community can achieve more positive outcomes. In describing the efforts that created a platform for active engagement with members of the ECOvision project, this study shows how university-based initiatives with school communities can work and even expand beyond the terms of the project.
Project ECOvision was based in Mashamba village, a rural community in the Venda region of South Africa’s Limpopo Province. Partnering with teachers and staff at the Mashamba Presidential Primary School, the project was designed to help the school use a more fuel-efficient way to cook school meals. Each day, community volunteers prepared lunch for over 900 students by heating water and grains in large aluminum cauldrons over open wood fires. This method wasted wood (an already depleted resource), and emitted unhealthy levels of smoke pollution (because the fire was not contained) within the partially enclosed kitchen.

Over a two-year period, a site assessment was conducted as well as research on efficient cooking alternatives. It was determined that working with the local teachers to create lesson plans about the stoves and other alternative energy sources would best integrate the project into the community. During the research and design stages it became obvious that community involvement was necessary at all stages and that research should focus on this aspect of the project.

**Approach**

*Identification of the “Problem” and Selection of Improved Cooking Method*

Project ECOvision was an evolution of collaborative thinking and problem solving initiated and defined by the Mashamba community. Since 1998, Professor Spreen has been working on a school development research project in South Africa and frequently visits the Mashamba school. In the fall of 2008, Spreen presented the problem of deforestation and inefficient cooking methods in Mashamba to UVA’s “Engineering in Community Settings” course. Several members of the class formed the ECOvision team and the group researched alternative cooking methods given the constraints of resources, time and money.

In the summer of 2009, a subsection of the group went to South Africa to further investigate the project and to present 3 different cooking apparatuses: a solar cooker, a biodigester and a more efficient wood burning stove. Most importantly, the pilot group went to Mashamba with an open mind and set out to share the research on the positives and negatives of each option with the community and described how each would work. Meetings with the teachers, the School Governing Body and Tribal Council resulted in the community's decision of the stove as the optimum choice.

After the summer pilot in 2009, the group continued the research and wrote funding proposals. Since ongoing communication with the hosts was limited due to lack of Internet and limited phone service in the village, this site assessment provided an important introduction to the community leadership, its culture and constraints, and an agreement on proceeding with the stove as the preferred option. While the design process itself involved little community engagement prior to the summer visit, the designs were considerably altered with input from the community to best fit local resources and constraints once on the ground.

From the more technical side, in researching different models of stoves the group considered various designs of large-scale rocket stoves and found the Apprevecho Research Center to be...
the most helpful resource. During initial site visits, the group observed the women who cooked the school lunches and spoke with them to glean their insights in creating a design that was acceptable and usable. During the design stage, which spanned one year, continuous discussions, experimentation, and assessments of resource availability further guided modifications upon the second visit.

**Implementation and Sustainability of the Stove**

Across five weeks in the summer of 2010, the ECOvision team designed an insulated stove with a chimney that retains heat more efficiently, thus decreasing the wood used, while funneling smoke outside the kitchen. In order to make Project ECOvision sustainable in the Mashamba community, the group took many actions encouraging community engagement and establishing ownership. Town meetings were forums to discuss different options and to create an open dialogue between the group and the community. The community was encouraged to meet at the primary school to make suggestions for stove design. Local knowledge was also actively sought, as when the team consulted with a local woman, Miriam, about her traditional clay oven. To ensure maintenance as well as replicability, only local material purchased within 50 kilometers from the school was used. Though Mashamba is a small village with few resources, some materials such as cement, aluminum for the roof and certain tools were procured from the general store. The local pottery supplied ash from firing their pots which was used in the insulating bricks – these were made by Caroline Nukari, a brick maker in Mashamba. Remaining materials and steel pieces handcrafted by Retha Henning were bought in the immediate area. The group also worked with a skilled mason, Joel Mushaku, who built the stoves. Additionally, the learners at the primary school were engaged in the process of building the stove.

**Education**

The education component of the project was crucial to its sustainability. In actively listening to and learning about the needs of the Mashamba community and incorporating the current best practices of curriculum design, a global sustainability curriculum unit was designed and piloted at the Saturday Enrichment Program (SEP) held at the University of Virginia’s Curry School of Education. Also in the pilot year (2009), workshops engaged sixth and seventh grade students at the Mashamba school. Students were given a brief lecture on the current wood energy usage and alternative energy options, and then in small groups they were asked to design their own stoves. This curriculum provided the foundational experience for working in the Mashamba Presidential Primary School. In fact, many of the design ideas that the children came up with were very similar to the final stove we built. In order to ensure a deeper understanding of and commitment to this project, a teacher workshop was also held in Mashamba. Collaboration with the teachers on developing a curriculum introduced the children (and their curious parents) to larger, more abstract ideas of environmentalism, resource usage and problem solving with the stove as a practical case study. The emphasis of the workshops was on teacher formulation of a curriculum that actively engaged students in learning about science, a method that both teachers and students, (who were used to rote repetition of material from limited resources),
found challenging but stimulating. In addition, in collaboration with local university students and community members, a comprehensive and user-friendly manual for building the stove was drafted to encourage further stove construction in other settings. The team recently heard from the teachers that several schools are interested and at least one school plans to start construction this year.

Team Building and Cultural Immersion

The ECOvision group took steps fostering teambuilding among members and the community. First, to learn about the broader history, politics, culture and environment of South Africa, a majority of the group members participated in parts of the UVA Southern Africa study abroad program prior to full immersion within the community. In the study abroad course, taught by Professor Spreen and Professor Swap (College of Arts and Sciences), students met with local leaders, scientists, farmers, students and others. Upon arrival in the village, all of the team members were invited to live in the homes of three of the teachers, Errol Mudau, Selina Mbedzi and Alex Mashamba, for the 5 weeks of fieldwork. This was an essential part of learning about daily realities, gaining acceptance in the community and building reciprocal relationships. In this and other ways, the group became part of these Mashamba families.

Connections were also made with the students in the Global Sustainability Club at the University of Venda (a nearby university sharing a decade long relationship with UVA through Professor Swap) with the aim of facilitating communication with the community, assisting the group with learning about and traveling around Venda and other parts of South Africa, and connecting with other local experts. Due to the pre-established networks with UVA faculty, relationships with other South African university students (both from UNIVEN and the college-age children of the Mashamba teachers) gave the group a unique window into the community. Lastly, at daily meetings and debriefings, the team discussed perspectives on the day's work, as well as the positives and negatives of the project. Individual members kept daily journals and recorded the experience for present and future reflection.

Findings and Discussion

In terms of active community engagement, Project ECOvision brought many successes and learning experiences. Though it is impossible to achieve complete community engagement due to limited telecommunications and problems of time, history, language and perception, the project was successful because efforts were made to actively involve the community.

Living with local teachers was most critical. The teachers were not only respected leaders within the school, but they were knowledgeable about the community and its customs, serving as important gateways to the larger community. Because of the trust and confidence they had in group members, they related perceptions and opinions to the group that other community members were unwilling to share. In this way, the teachers mediated and navigated the complicated politics and hierarchies within the school and village, the details of which the group was previously unaware of and would have been unable to overcome alone. The gesture of living in the village
fostered additional respect and trust from the community. It ensured that group members became familiar faces rather than clueless outsiders. Home-stays maximized time to discuss and share the project with the community, involving them in important steps. Therefore, the home-stay was not only essential in ensuring efficiency and good relations with the major stakeholders but also in altering the community’s perceptions of the group as outsiders.

The project also aimed to maximize opportunities for community members to share their opinions, knowledge, and insight about the project through meetings with the school cooks, Tribal Council meetings and “office hours.” Though sparsely attended, suggestions that arose at the office hours, such as using a metal framework to stabilize the pot, improved the final product. Other relevant local knowledge was sought, which illustrated how the rocket stove design could be altered and how certain materials could be eliminated to fit local conditions and materials. The group found that opening the space for other ideas and admitting when they didn’t have answers was critical toward the willingness of others to work with the team.

One indicator of a sustainable project is that can be carried on and maintained by the members of the community. Thus, one major goal was to source the materials locally and as cheaply as possible so they would be affordable, readily available and easily replicable. Joel Mushaku, a skilled mason, executed the construction of the stoves. Though Joel had other obligations, he was willing and able to provide essential skills that improved on the stove design by tweaking them to the site, climate and materials. He was also a crucial link to the larger community, particularly those involved in construction. His expertise enabled the group to finish and test one stove despite numerous delays, and he was inspired enough to finish building two more after the group’s departure. The school has since reported three working stoves, which another school in the area is looking to replicate with the help of Joel and the manual.

Despite a successful outcome, largely due to active collaboration with the community, there were inevitable misunderstandings and obstacles. Time was perhaps the most prominent of these. Lack of time hindered the group’s ability to fully integrate with the community. In addition, time constraints pressured the stove’s construction and completion. The project experienced several delays – for example,
due to weather conditions, the insulating bricks were not drying effectively and many of them cracked. Meetings were constantly postponed and many people arrived late. The ECOvision group reached two main understandings. Firstly, people have other important commitments including earning livelihoods and advancing their own education. Secondly, the idea of time is culturally constructed, and the concept of “wasting time” meant very different things to the team and to the community members. Active engagement requires time as well as the patience to let others determine the pace, efforts and timelines of a project.

The group also encountered another common problem in development projects. Despite living with local teachers and bonding during previous visits, the group never completely overcame the “insider” and “outsider” duality. For instance, community members did not immediately share some of their concerns. Not until the final meeting was it revealed that using cow dung in biodigesters would have upset farmers who use the resource as fertilizer for their crops. Miscommunication may have been caused by the community’s fear of upsetting the group and disturbing their pre-existing relationship with UVA or it could have been a product of historical patterns of distrust leading to a lack of disclosure regarding contested issues with outsiders. The legacy of racial apartheid in South Africa also might have implications for patterns of behavior around race, class and even gender. Hence stereotypes of the group as wealthy outsiders were also evident on occasions when group members were asked directly for material gifts, and the teachers related that some community members questioned why they were “running around with those white people.” These perceptions were first suggested at the initial meeting with the Tribal Council when a rowdy man who was skeptical of the project was asked to leave by the tribal elders after he shouted the words “empty promises.” While expelling him from the meeting was perhaps meant to preserve the community’s relationship with the team, members were concerned that prohibiting him from expressing his concerns was not in line with the vision of broad-based community engagement. Because of the team’s status as “outsiders,” fully understanding the community’s priorities and reaching certain classes of the population was challenging.

Many attempts to overcome incidences of exclusion and to involve more citizens with “office hours” style meetings were largely unproductive due to low attendance. It was also difficult to communicate directly with all the different stakeholders - particularly the school cooks themselves. Language barriers as well as translation issues limited the group from open conversations. As with all translations, teachers’ translations from Tchivenda into English may have reflected biases, perhaps failing to fully represent the voices of the cooks. Those in the community who spoke limited English often exhibited a reluctance to speak. The ideal approach of visiting members of the community and reaching out to them individually may have been more effective and culturally appropriate, but the group was constrained by time and language.

Another cultural difficulty was the lack of understanding regarding Mashamba’s hierarchy and values that emphasized the community over the individual, often at the expense of efficiency and expediency. For example, in communicating with this community from overseas, correspondence was primarily through village teenagers because they were most responsive to electronic
communication. In doing so, our group violated the local hierarchy and upset stakeholders. In another instance, when the group asked the host teachers to hold meetings in their classrooms, other teachers took offense at the unintentional exclusion. Following advice from a teacher, the team learned to put one designated community member in charge of planning and communication decisions so as not to cause any unforeseen problems. These lessons illustrating the difficulty for outsiders to understand the nuances of traditional hierarchies and power structures within the community further suggest that deliberations and solutions to local problems should be structured through stakeholders themselves. Yet, an important observation was that despite the local capacity, resources and willingness, without the connection with the team, particularly our questions, ideas, research and outside push, none of this would have been put into place.

Conclusion

The team’s openness about the project, willingness to ask questions and actively engage with all community members in all areas of the project, and UVA’s longstanding ties with knowledgeable and influential leaders and stakeholders, was crucial in making Project ECOvision successful. Though only one stove was finished at the end of five weeks, efforts to work with the community means that the product is relevant and useful because it fits their needs and functions properly. Though it is logistically challenging to engage all individual views and difficult to overcome reluctance to volunteer opinions and information, the team’s interest in active community participation opened most potential avenues for involvement. Based on the team’s experience and the revelations uncovered in the last week of the project, active community engagement and time - to become familiar with the culture and community, build trust and engage with all major groups and stakeholders - were the most important factors (beyond good intentions) in assuring project success. Based on continued conversations with the Mashamba community, the community took ownership of the project and completed it after the team’s departure, and will hopefully continue to do so in other settings. Thus, beyond the improvement in wood and resource usage, and decreased smoke inhalation, the most important result of the project was the recognition by the village that they have the ability to enact and perpetuate positive change in their community.

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*El Codo Rocket*. Energia, Ambiante y Salud. ENASA.


Biographies

Carol Anne Spreen is a professor in the Curry School of Education’s Leadership, Foundations and Policy department and has had a relationship with the Mashamba community for 12 years.
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Abstract

This report offers a multidisciplinary study of the social, cultural, historic and economic implications of the Royal Caribbean and IDEA, Inc. tourism development project in Falmouth, Jamaica. Research of the new wharf development and existing conditions have informed recommendations which are intended to create a sustainable development, with shared benefits between the new tourism industry and the existing historic fabric and community. While this report stands alone as an independent academic exercise, it has been made freely available to development stakeholders (developers, local and national government, private non-profit entities and residents) and other interested parties so that it may help maximize the development’s benefits for Falmouth and its residents.

This project developed from the research team’s involvement in the University of Virginia’s Falmouth Field School in Historic Preservation which engages students in many aspects of preservation in the culturally diverse and economically complex Caribbean context.

Introduction

Tourism often holds out the promise of jobs and opportunities to economically struggling communities, but examples of tourism development that fail to live up to promises are plentiful. This is particularly true in developing countries. A group in Montego Bay, Jamaica recently convened to address issues of vice and unpleasantness on its “Hip Strip” tourist area and make recommendations for redevelopment. Thirty miles away, Falmouth offers an opportunity for a stark contrast to the problems of the Hip Strip. Despite its international recognition for its architectural fabric and role in 19th century global trade, major tourism development has bypassed Falmouth until last year.

A small town on the northern coast of Jamaica, Trelawny Parish, Falmouth was founded in 1769 and developed around a large and easily-accessible wharf. A critical port in the Triangle Trade, Falmouth received consumer goods and slaves from Europe and Africa and exported sugar and rum to America and Europe. After Emancipation in 1834, the loss of slave labor caused many plantations to fail and industry at the port slowed. The port remained active until the 1950s, but never again saw the thriving prosperity of the pre-Emancipation period. As a result, the town never experienced significant redevelopment and today many of its residential and commercial buildings date back to the 19th century.
Seeing a revenue source in its historically intact fabric, the Port Authority of Jamaica (PAJ) recently began investigating opportunities for development in Falmouth. PAJ signed a contract with Royal Caribbean Cruise Lines (RCCL) in 2007 to make Falmouth its newest cruise ship destination. Construction began in September 2009. The redeveloped wharf is an 11 acre wedge of infill built on top of the historic wharf. It has ship berths on two sides and a reproduction Jamaican townscape at its center.

The port, as designed by RCCL and its design firm IDEA, Inc., will accommodate the *Oasis of the Seas* – the largest cruise ship in the world – and is expected to bring to Falmouth, a community with virtually no tourism industry, more than 650,000 tourists annually. Such dramatic and abrupt change is bound to result in short-term growing pains; the long-term prognosis is more challenging. The worst case envisions, as a resident of Falmouth put it, “the wharf… disconnected from the rundown town”; the best case envisions a model community for sustainable heritage tourism development.

Based on case studies of existing tourist destinations, the research team defined a sustainable heritage tourism development as a place where:

- Development preserves the town’s historic character
- Tourism benefits are accessible to all residents
- A culture of stewardship is instilled in visitors and residents
- The tourist and resident communities comfortably coexist in a shared landscape
- History is presented wholly and accurately by appropriate entities

The research team intended to assess what best practices can be employed to maximize benefits and mitigate possible adverse effects from the wharf development in Falmouth.

The timing of this development, combined with the significance of Falmouth’s historic resources, offers a unique opportunity for the cruise industry to exhibit leadership toward more sustainable tourism practices.

**Research Methodology**

The team worked in three collaborative groups – public history, architecture and planning, and community and economic development – to study how decisions made in these intersecting fields can positively affect Falmouth’s social, economic and physical landscapes. The public history team studied how Falmouth’s rich history can be presented and disseminated to benefit both community members and visitors. The architecture and planning team examined the built environment to address how design might ease the impact of development on the community. Finally, the community and economic development team studied how the development could fit best into existing community structures.

There were three phases to the project. The first phase included background research consisting of literature review and case studies of tourism in: Marseilles, France; Mauritius; Quintana...
Roo, Mexico; and Cava Sidero, Crete. The second phase, Falmouth-based fieldwork, consisted of formal interviews, observations and photographic documentation, and surveying, all conducted according to IRB standards. Formal interviews focused on decision-makers and stakeholders, including individuals from: RCCL, the development company; Falmouth Heritage Renewal, Falmouth’s historic preservation organization; governmental officials like the Mayor and the town Custos; educators such as the librarian and the primary school principal; various business people; and employees of social service and workforce development organizations. These interviews were not tape recorded, but for each interview at least one team member took notes and wrote summaries. The team’s observations and photo documentation while in Falmouth was another large part of the data gathering that informed final recommendations.

In recognition that the interviews failed to capture the opinion of the general public, we constructed two surveys – one for Bend Down Market (an outdoor community market) and one aimed at residents of the historic district as part of the second phase. The team went to Bend Down Market on Wednesday, March 10, 2010 to conduct surveys about impending changes and benefits due to the wharf development. Respondents included 207 adults (86 males and 121 females). On Thursday, March 11 and Friday, March 12, 2010 the team surveyed people on the streets of the historic residential district. Residents were asked how they felt about tourists in their neighborhood, and how well-informed they felt about the wharf development. Respondents included 30 adults (19 males and 11 females). Probabilistic samples were not feasible given our data collection methods and the lack of population statistics available to us. Respondents were strictly voluntary and as white American researchers we received an undue amount of attention, both of which may have skewed the results. Given these restraints, we compiled as complete a cross section as possible regarding the typical Falmouth resident’s opinion on the effects of the development on their community.

The final phase was a synthesis of the research and findings into a report, made available to all stakeholders and citizens of Falmouth. The report recommended action steps to enhance the sustainability of the development.

Results

Field Work Findings

The following is a series of critical observations about the wharf development and its relationship to Falmouth gathered during our fieldwork. These observations provide a basis for the recommendations offered under “Discussion and Recommendations.”

1. Developers and community leaders have different ideas about the implementation of the wharf project.

Different stakeholders responded with conflicting answers to the same questions during interviews. The most significant question revolved around the possible presence of a physical barrier between the development and town (personal communication with Peter Brand, March 9, 2010
Stakeholders also disagreed about the timing of various phases of the development, particularly the relocation of the community market (personal communication with Peter Brand, March 9, 2010; Hugh Darley, March 8, 2010; Mayor Colin Gager, March 8, 2010).

Community leaders and developers claim they want tourists to leave the wharf and explore the town, yet the *Oasis of the Seas* is both designed and billed as an all-inclusive destination. In Phase I of the development parking lots and service areas, which function as spatial barriers, are positioned between the wharf and town, suggesting an inconsistency between the desire for tourists to leave the wharf and the developer’s plans.

2. No clear plans exist for preservation of history/historic fabric.

RCCL and IDEA are drawn to Falmouth because of its intact (yet crumbling) historic fabric, but the town lacks the money and skills to protect and maintain its historic resources. The designated historic district has design guidelines, ordinances and an architectural review process, but these tools are underutilized. Local historian Marina Delfos and Dr. Jim Parrent of FHR (personal communication, March 8 and 9, 2010) both indicated that resources have not been allocated for protection or restoration of buildings, particularly in residential areas. Residents are concerned that rapid redevelopment will cause Falmouth to lose its distinctive character.

3. Investment in the parish lags behind investment in the new development.

PAJ has pledged $US 212 million for the new wharf development (“Falmouth Wharf,” 2009). In October, 2009, Jamaica’s Tourism Product Development Company (TPDCo) released its plan for Phase I of the Falmouth redevelopment, but as of March 2010, they had no office in town and interviews suggested this plan had been abandoned. National Tourism Enhancement Funds are not being spent in Trelawny Parish. The Urban Development Corporation (UDC), a federal agency, is preparing plans for redevelopment, but is focused on infrastructure rather than aesthetic improvements to meet tourists’ expectations.

In contrast to the optimism of the citizen surveys, numerous informed stakeholders expressed concern in their interviews that tourists will not leave the new wharf development to explore the town if they do not like what they see. TPDCo’s community redevelopment plans include solutions to address this concern, but they are not yet implemented. Similarly, without efforts to develop inland excursion destinations in Trelawny, Falmouth’s visitors and opportunities for profit will be redirected to well-established destinations in nearby parishes built to support well-established ports in Montego Bay and Ocho Rios.

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1 Mr. Darley (IDEA) presented the wharf design as open and permeable – a notion echoed by town officials – while Mr. Brand (RCCL) indicated a fence would be installed between the wharf and the town, to close-off the wharf when needed.

2 Mayor Gager expected that Bend Down Market would be relocated during the first phase of development whereas information gathered from IDEA and RCCL interviews and planning maps showed the relocation of the market in later phases of the project.
There is further concern that economic opportunities are inaccessible to local business people. Commercial leasing and advertising prices within the development are based on American or European budgets, effectively pricing out local businesses within Falmouth’s pre-wharf economy. Loans for business improvements or expansion seem to be out of reach for most local business people. Speculation is already driving up real estate prices, creating the possibilities that commercial space will be affordable only to foreign entities and Falmouth will be inaccessible to local Jamaicans.

4. The developers’ sense of urgency is not matched by community entities.

Falmouth residents have seen potential economic development projects fail to live up to promises, either because they were promised but never delivered, or were delivered but failed to perform. Consequently, a wait-and-see attitude is compounding laid-back cultural tendencies. With the first ships arriving in early 2011, few locals will be ready to take advantage of jobs or tourist dollars.

There is also a short window of opportunity to see this project succeed. Stakeholders speculated that window is as short as 12 months and not longer than five years (personal communication with Custos Muschett, March 9, 2010; Omar Simpson, March 11, 2010; and Dr. Jim Parrent, March 8, 2010). By the end of that time, tourist buzz about the value of the destination will have solidified and residents will have determined whether or not they benefit from the development; both perspectives are essential to long-term sustainability and success.

5. Falmouth lacks civic leadership opportunities for residents.

Falmouth has few formal avenues for residential or business community leadership. Civic organi-
organizations are stagnant, and the Chamber of Commerce does not have a wide membership or meet the needs of the business community. While there are strong social ties between residents and in churches, there are no service organizations to affect grassroots community change and no easy way for outside developers to interact with people over concerns about the development.

6. Water Square is a vibrant, integral part of the community.

Water Square remains a vibrant, integral part of the community because of its grocery stores, shops, taxi stand, proximity to Bend Down Market and its use for open-air public concerts. We estimate that most residents find themselves at Water Square at least monthly, some daily. On the other hand, the tourists will be a part-time presence in the community.

7. Possibility of civil unrest exists.

Jamaica is a developing country with a heavy debt load, profound poverty, high unemployment and a government that is perceived as distant and out of touch. The country is economically and politically unstable, and outbreaks of civil unrest have shown that demonstrations and riots are outlets for civic disaffection. Riots in May 2010 over the extradition of Christopher “Dudus” Coke to the US are an example of what could occur if the wharf project is managed poorly.

8. Plans for the interpretation and preservation of history lag behind plans for commercial areas.

Ideas of how history will be interpreted in formal settings are not well developed. The Tharpe House (the only historic building in the wharf complex) will become a museum, but it is unknown who will prepare the history to be presented and who will fund the museum. Plans call for other museums in town (the Courthouse, School/Barracks, Barrett House) but no organization is responsible for restoring these locations. No plans exist to interpret the ample research on the history of Falmouth’s 18th and 19th century buildings. Concerns exist in the preservation community that the history being told is influenced by the demands of tourists over accuracy (personal communication, with Hugh Darley, March 8, 2010), including plans to interpret a history of piracy even though it had no strong presence in Falmouth. Similarly, Georgian history has been chosen as the period of significance within the development, while history from Emancipation to the present is given scant attention.

Survey Results

Subjects in the survey at Bend Down Market indicated that they were generally very positive about the prospects of improvements from the development, with some hesitation about the possibility of their market being relocated five blocks away. Each respondent was asked the four questions be-

How do you feel about the possibility of tourists walking through your neighborhood and taking pictures of your home?

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<td>Neutral (3)</td>
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<td>Very Good (5)</td>
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They answered on a five-point Likert Scale where $1 = \text{Very Bad/Strongly Disagree}$, and $5 = \text{Very Good/Strongly Agree}$.

The average results across all respondents were as follows:

Subjects in the residential historic district survey were overwhelmingly positive about sharing their neighborhood with tourists, but had mixed feelings about whether they were fully informed about the project. Each respondent was asked a number of questions about development of the wharf. Again they answered on a five-point Likert Scale where $1 = \text{Very Bad/Definitely Not}$, and $5 = \text{Very Good/Definitely Yes}$. On the histograms below, the horizontal axes measure number of respondents.

In general, the people surveyed appeared to have a more uniformly positive outlook on the development than the decision-makers and stakeholders interviewed.

**Discussion and Recommendations**

This research uncovered two conditions that must be addressed for the wharf project to be sustainable. First, there is a consistent imbalance in decision-making authority and miscommunication of development priorities between constituencies, as well as an imbalance in opinions toward the development between the decision-makers and the people in the street. Second, multiple stakeholders mentioned the issue of time-sensitivity – there is a limited window of time before it will be too late for the town of Falmouth to realize potential benefits of this development. Recommendations for next steps are:

*Primary Recommendation: Water Square as a Shared Public Space*

Water Square, the current center of Falmouth culture and commerce, should be re-envisioned as a shared public space, linking the new wharf development to the historic district, and the existing community to visiting tourists. Water Square can act as a center of social and economic exchange and the relaying of public history, meeting the needs of both tourists and locals. Its proximity to the wharf development offers an ideal opportunity to encourage land and cruise-based tourism, revitalize the historic town fabric and foster meaningful interaction between tourists and residents.
Recommendations for Water Square by Theme/Focus/Team:

1. Public History

**Goal 1:** Ensure publicly-presented Falmouth history is told by Jamaicans.
- **Strategy:** Develop a partnership among Jamaican heritage NGOs/agencies to review interpretations.

**Goal 2:** Interpret the diverse post-Emancipation history of Falmouth in and around Water Square.
- **Strategies:** Interpret political, environmental, architectural and cultural histories in relevant locations around Water Square.

2. Architecture and Planning

**Goal 1:** Ensure Water Square and surrounding areas remain accessible and welcoming environments for both residents and tourists.
- **Strategies:** Improve pedestrian access (including spatial and programmatic connections) to Water Square from the wharf; create a street cleanup/improvement program; include public performance/musical heritage space and programming in Water Square.

**Goal 2:** Ensure new development and changes to historic structures adhere to the historic character of Falmouth.
- **Strategy:** Implement Jamaica National Heritage Trust Historic District Guidelines.

3. Social and Economic Development

**Goal 1:** Create Water Square Business Association (WSBA) to offer locally-owned businesses access to economic opportunities.
- **Strategies:** Ensure access to tourist-geared advertising outlets for member businesses of all sizes; use WSBA as a single point of contact within the business community for development-related interactions with various agencies and organizations; provide business owners access to micro-credit for improvements.

**Goal 2:** Protect the local social and economic presence in Water Square so it continues to serve as a community space for citizens.
- **Strategies:** Obtain/maintain office presence in Water Square business district for at least two wharf-focused economic development organizations; offer preferential rental rates to locally-owned businesses in Albert George Market.

Conclusions

Creating community support is a common thread in our recommendations, and while we focus on Water Square, it cannot stand in isolation – significant considerations must be addressed in greater Falmouth. Further supporting actions by all constituencies are integral to a sustainable future for Falmouth.

The town of Falmouth and RCCL have an opportunity to illustrate how successful profitable development can be to the environment and to host communities. But they must enact change in an ever-narrowing window of time. The opportunity to mold Falmouth into an attractive des-
destination in the minds of tourists and locals alike is time-sensitive. This report’s suggestions for what might be accomplished require some investment and cooperation, but the results could be ground-breaking in the global cruise and heritage tourism industries.

Biographies

**Katherine Brady** attended the 2009 Falmouth Field School in Historic Preservation and graduated from the University of Virginia’s School of Architecture in 2010 with a Master’s Degree in Urban and Environmental Planning.

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Abstract

*Initiative reCOVER* is a comprehensive architecture research + design + build program that involves the skill sets and knowledge of architecture students to aid victims world-wide in post-disaster situations. With the belief that safe shelter is a basic right, the group has focused on housing for populations with restricted access to safe living environments. At the forefront of these designs are both human comfort and environmental considerations, achieved through the incorporation of sustainable building practices and community planning strategies. *Initiative reCOVER* aims to collaborate with non-profit organizations, manufacturers, and professionals both locally and abroad to create a robust network of contributors to achieve the goal of healthy and safe living environments for occupants.

Introduction

*Initiative reCOVER* believes safe, healthy, and well-built housing constitutes a basic human right and aims to address urgent housing needs in post-disaster situations or areas otherwise requiring readily available and cost-effective shelter. Recent natural disasters including Hurricanes Katrina and Rita of 2005, which devastated the Gulf Coast region of the United States, and the earthquake that struck Haiti on January 12, 2010 have served as catalysts to finding solutions for rehousing those who have been displaced. Evidence shows that many current housing solutions in post-disaster situations are unsuccessful in their ability to adequately respond to the demand of shelter and are often unhealthy and uncomfortable.

*Initiative reCOVER* created a partnership with the Building Goodness Foundation (BGF), a volunteer-based non-profit organization headquartered in Charlottesville, Virginia in 2008 to address issues of transitional housing and shelter in the Gulf Coast region of the United States after hurricanes Rita and Katrina. After working for many years in the region by assembling and transporting teams of volunteers and construction professionals to the Gulf Coast to build low-tech and affordable temporary shelters, they have expanded their breadth of charity work internationally. With the Haiti earthquakes of January 2010, the Building Goodness Foundation’s (BGF) extensive network of architects, engineers, and volunteers faced the challenges of building internationally in a country decimated by natural disaster, disease, and corruption. BGF’s experience with building in these areas has provided *Initiative reCOVER* with helpful information on how to approach a potential solution for problems in Haiti. With their input,
Initiative reCOVER has designed, developed and tested a more efficient means of producing and assembling transitional houses to be implemented worldwide. This partnership, initiated in the fall of 2008, has resulted in a hybridized approach to construction; designs for housing combine the effectiveness of high fabrication tolerances of off-site prefabrication processes and an open building system approach to manufacturing, supply and on-site assembly. A panelized building design allows the reCOVER homes to be built, flat-packed, stored, delivered to the building site as needed and assembled in a matter of days. The housing solutions proposed by reCOVER address the immediate and future housing needs of communities while accounting for a protracted recovery phase.

An important part of both BGF and reCOVER’s philosophy for reestablishing communities that have experienced such great loss is to respect local customs and values. The reCOVER homes are adaptable and can be altered to serve the culture and climate of the region they intend to help. The proposal for rebuilding Haiti, for example, responds to the local cultural heritage and domestic tradition while incorporating new construction techniques and renewable energy technologies. Locally sourced materials and construction methods are an important part of gaining community involvement and appreciation for the new structures. Architectural and engineering design integrations ensure safe and optimal performance of the housing’s structure and living environments. Simple strategies of passive environmental design introduce optimal natural indoor light and ventilation to the interior of the home while maintaining a close visual link to exterior spaces which helps to promote social interaction and a familiar sense of community. Conceived as an adaptable system, the reCOVER housing proposals holistically integrate these design criteria with the purpose of making a sustainable link between housing and health.

With the use of thoughtful building techniques, reCOVER strives to reestablish communities and improve living situations with efficient and desirable homes.

**Prefabricated Panelized System**

Initiative reCOVER’s housing design is based on a prefabricated construction process. The panelized building approach allows the building components to be manufactured off-site in a controlled factory setting and shipped to their destination in manageable pieces ready for efficient assembly. The prefabrication of the reCOVER housing design ensures a high degree of construction quality, which in turn affects the overall performance, longevity and durability of the building. Major considerations of the prefabrication process are how the design will be transported and how it will be assembled, especially in remote areas without access to electrical power. Initiative reCOVER addresses this issue with the panelized system. Building components can be easily flat packed, shipped and assembled on any site with simple hand tools and without the use of heavy machinery, cutting down on construction costs and broadening the range of accessible building sites.

The panelized wall system is an integral element to the design’s functionality and flexibility. The wall panels are four foot by nine foot wall sections that integrate everything from insulation to windows, forming one cohesive building component. The panels utilize engineered lumber as
the structural frame and a mechanical camlock connection system. The camlocks, simple hook and bar locking components, serve as the connecting mechanism between adjacent wall panels. This hardware is not only strong and structurally reliable, but also user-friendly and requires only the use of an Allen wrench to secure the connection while ensuring ease of assembly and disassembly. The ability to demount these shelters allows individual units to be disassembled for necessary repairs and maintenance, or for their relocation and reuse at another site. The panelized building approach also allows the buildings to be easily modified to accommodate a wide range of family sizes.

Another implication of the design’s easy assembly is the opportunity to directly involve the local community in the building process—with the aid of one trained supervisor, a small group of Haitian volunteers with little to no construction experience can easily assemble one house. Although not field tested in its entirety, it is estimated that one home can be constructed in one to two days. reCOVER seeks to use the design as a means to restore a devastated community by physically reconstructing the built environment, but also by revitalizing the spirit and psyche of the Haitian people by including them in the process of rebuilding. Ultimately, this involvement will help sustain a sense of pride and ownership for the Haitians who live in these homes.

Design Development

The aesthetic development of the reCOVER homes, along with proposed schools and community buildings, is the result of careful consideration of how performative and aesthetic aspects of the building designs can fit more seamlessly into the existing cultural fabric of their sites. One such project is the Breathe House that integrates forms and colors that embody the strong cultural identity of Haiti. Brightly colored exterior facades are a domestic tradition in Haiti, and reCOVER’s design accommodates and encourages each family’s right to modify the exterior of their building with a color and material palette of their choice. By including a degree of flexibility in the design, the Haitian homes are not only welcoming and visually appealing, but they also allow the opportunity to establish a sense of identity for the inhabitants. By providing opportunities for individual customization, the house becomes something the occupants can truly call their own and something that grows and changes with their use over time.

The spatial organization of the reCOVER housing unit is another aspect that draws from the Haitian culture and shares direct ties to traditional Creole houses. A single pitched roof and generous fabric canopy structure that shades the exterior porch reference a traditional gable roof common to many

Ventilation diagram showing UV lights and ceiling fan in Breathe House.
Haitian abodes. The entry porch provides a welcoming covered terrace that allows individuals to spend leisurely time outdoors while staying protected from the intense heat of the sun. It grants direct access to the interior living space and kitchen area of the home. The more private sleeping quarters and bathroom are placed away from public view and accessed through an extended threshold defined by a central amenities unit that helps to organize the space. This layout not only provides a familiar interior floor plan with which the inhabitants are accustomed, but also provides open circulation and reinforces the indoor/outdoor relationship, both critical elements to optimize the effectiveness of the housing unit’s other performance criteria.

One of the large obstacles tackled by the Breathe House proposal is to provide the necessary space and sanitation to limit the spread of tuberculosis in living environments amongst family members. The design combines the effects of passive design strategies with a simple interior air sanitizing system that helps to continuously replenish and circulate fresh air through the building and thus limit the spread of airborne bacteria. The housing unit is oriented on the site to take advantage of the Caribbean trade winds that provide steady cross-ventilation through the living space. Low-volume ceiling fans powered by a photovoltaic array further facilitate circulation within the building as air is drawn from low vented windows and expelled from the building through additional ceiling vents. As the air circulates along this path, it passes over UV sterilizing lights mounted on the walls near the ceiling that kill bacteria and help to purify the air. These simple air filtration techniques are adopted by the reCOVER team to eliminate stagnant air spaces where disease can fester and spread.

The design also provides an individual sleeping space to separate the healthy family members from the sick. This auxiliary sleeping unit consists of a small bedroom, bathroom, and personal storage space. The two units are architecturally linked by a serene outdoor breezeway which is covered by the awning and roof overhangs. The outdoor connection provides the necessary separation between the sick and healthy family members but does so in such a way that the two spaces remain interconnected, eliminating any feeling of alienation or segregation by the inhabitants.

**Looking Forward**

Initiative reCOVER will continue to develop the design of transitional disaster recovery housing and work to expand its application over a variety of potential environments. In consideration of future projects, the design team aims to expand on the versatility of the panelized construction system to fit the programmatic and cultural necessities of each application while integrating the use of new materials and technologies in the building.

Over the summer of 2010, the reCOVER team began collaboration with Building Haiti, a program founded by a University of Virginia student that aims to support Haiti through the improvement of its educational buildings. Hoping to construct the first of fourteen modular, single-classroom buildings in the fall of 2011, Initiative reCOVER will work alongside Building Haiti to create the new Jean-Charles school campus in Thomonde, Haiti which will serve students from first to twelfth grades. Using the panelized wall system as the basis of construction, the design of
the schools will also employ local labor in the fabrication of Interlocking Stabilizing Soil Blocks (ISSB) that will be used in the structure of the classroom. Both construction methods are designed to engage local Haitian manufacturing and promote job creation by using readily available resources, such as bamboo for panel cladding and soil for block making, while reducing the environmental impact of importation and transportation of building materials from abroad.

In the fall of 2011, Initiative reCOVER participated in a global architectural competition sponsored by Architecture for Health in Vulnerable Environments (ARCHIVE Institute) that called for the design of homes which will minimize the transmission of tuberculosis particularly in the Haitian population currently living with HIV/AIDS. With 200 qualifying entries from five continents, Initiative reCOVER’s Breathe House won first place in this international competition and is currently working to have the house built outside of Saint Marc, a town 100 km northwest of Port-au-Prince, by the fall of 2011. Photovoltaic panels placed on the single pitch aluminum-clad roof will provide the house with enough electricity for small appliances, including low-volume ceiling fan units that will supplement passive ventilation strategies to provide optimal air circulation and comfort within the structure. Wall panels will be outfitted with sensing technology to monitor air quality, temperature and humidity inside of the building as well as ultraviolet air purifying lamps to sanitize air exhausted from the home. This clean, fresh air will aid in the recovery of the users of these shelters.

In addition to developing housing projects abroad, Initiative reCOVER is currently working locally to address homelessness in Charlottesville, Virginia. Working with the Thomas Jefferson Area Coalition for the Homeless (TJACH), the spring 2011 Studio reCOVER is collaborating with The Haven, a local homeless community assistance center, to provide transitional homes for the homeless population of Central Virginia and Charlottesville. By replacing vented windows with glazed windows and adding an insulation layer to the panelized system that will better fit the climatic conditions of the Charlottesville area, Initiative reCOVER plans to begin construction on the transitional shelters by the summer of 2011.

With the success of recent competition submissions and the potential application of these shelters worldwide, reCOVER hopes to positively affect the current state of transitional disaster recovery housing strategies and improve the lives of those in need.

Biographies

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Empowering Women Through Radio in Bluefields, Nicaragua

By Nicole M. Dompke, Sara E. Duke, Halley W. Epstein and Erin M. Thorpe

Abstract
The University of Virginia’s strong partnership with the community of Bluefields, Nicaragua has enabled students to utilize local connections for research and advocacy projects. Through this relationship and a grant from the Jefferson Public Citizens program (JPC), four undergraduate students, their graduate student mentor and a faculty advisor undertook a research project focusing on women’s issues in the region. The team learned through outside research and communication with UVA students who had conducted research projects in Bluefields in the past that radio would be the most successful manner of disseminating information (Kelly, 2009). Utilizing this information, the team partnered with a local university’s communications class and was able to record and broadcast radio programs focusing on women’s education to the surrounding area. During a trip to Bluefields in the summer of 2010, the team interviewed key informants, including women of various ethnicities and other community stakeholders, to research the most relevant topics to cover in the radio programs. Based on interview and research results, the programs were focused on sexual and domestic violence, women’s health and teen pregnancy prevention. Equally important to the radio program’s success was the use of JPC funding to replace radio transmission equipment and expand the local university’s radio outreach capacity. This proved to be a challenging aspect of the project due to legal and institutional barriers as well as communications limitations with the team’s partners in Bluefields. Ultimately, the team successfully developed multiple radio programs and sparked interest among the communications students to expand women’s radio programming and encourage improvements in gender equality in Bluefields.

Empowering Women Through Radio in Bluefields, Nicaragua

Bluefields is a coastal city that serves as the capital of the Southern Atlantic Autonomous Region (R.A.A.S.) of Nicaragua. The city’s population was 45,547 in 2005 in addition to several thousand Nicaraguans living in rural communities throughout the region (Bluefields Online 2008). An ethnically and linguistically diverse city, Bluefields has large Mestizo and Creole populations in addition to Garifuna, Rama and Miskito groups. Main sources of employment include fishing with significant seafood exports, light industry involving the production of cabinet woods and port and shipping services (Bluefields Online 2008). Due to limited employment opportunities, working abroad is common especially among the young adult population, with remittances sent...
to family members in Bluefields (Personal Communication with URACCAN students, May 27, 2010).

The World Health Organization (WHO) identifies domestic abuse and sexual violence as “major global public health problems” having significant negative impacts on “acute and long-term health and well-being” (2007). According to Graham and Bernards (2008), “violence against women has been recognized as a public health problem since the 1980s” in Bluefields. Studies conducted by the United Nations (UN) established that nationally, 30% of women report being physically assaulted by a partner in 1998, while a Bluefields community member stated that up to 80% of local women have experienced some form of sexual or domestic violence (United Nations 53, 2006; personal communication, May 27, 2010). Through communication with UVA students who had previously worked in Bluefields, the team learned that women’s access to information about combating violence, asserting one's rights and women's health was only available in Spanish and only in specific locations, such as the police station and the local hospital. Given the team’s interest in global gender equality and women’s rights, its members set out to utilize UVA’s existing connection with Bluefields to design a project that would best contribute to empowering the women of the community through information availability. Their goal was mainly one of primary prevention, aimed at addressing violence problems before they occurred, as these strategies “can introduce to particular population groups new values, thinking processes, and relationship skills that are incompatible with violence and that promote healthy, nonviolent relationships” (Wolfe and Gaffe, 1999). Public Service Announcements (PSAs) are often utilized for this purpose, as radio announcements can reach a broad audience and often include information about community resources in addition to messages about topics such as violence prevention and warning signs (Wolfe and Gaffe, 1999). Previous UVA students who worked in Bluefields found radio to be the most valuable communication tool for reaching out to women in the region (Kelly, 2009). As an advocacy tool, radio has been identified by the UN as “good practice,” an important method for enhancing “women’s awareness of their rights and of available remedies and services” as well a way “to expose and convey the unacceptability of violence against women” (United Nations 97, 2006).

Equipped with this knowledge, the team decided to first determine information deficits regarding women’s well-being and then provide this information to the largest number of women possible. The team conducted five key informant interviews with specially targeted members of the community that the team deemed as influential sources who would benefit the project, like the head of the women’s police branch, the dean of the nursing school, a planificación (family planning) nurse and the head of the psychological services department of IXCHEN as well as three focus groups consisting of ten students from the University of the Autonomous Regions of the Caribbean Coast of Nicaragua (URACCAN), a group of four radio programmers from Managua and two community members. Through these interviews and focus groups, the team discovered that better information and communications campaigns about sexual and domestic violence and women's health were particularly needed in the community. Per the team’s confidentiality
guarantees to these community members, they are not listed by name and are all referenced by “Personal Communication.”

One of the key informants, who works in the communications industry, explained that there were no PSAs about women’s health and the community’s struggle with violence against women being broadcast on Bluefields radio stations (personal communication, May 27, 2010). The team learned that violence-related topics have historically been considered taboo in Bluefields. Specifically, key informants told the team that there is a cultural stigma in the Creole community against denouncing and reporting violence (personal communication, May 31, 2010). One key informant (interviewee) added that many women of various ethnicities are too ashamed to admit that they are victims and that fear of repercussions from their partners may prevent others from seeking help (personal communication, May 27, 2010). By utilizing radio as a form of mass communication, the team hoped to provide information that women may have previously been too ashamed or afraid to request in person. Although measures to address these issues have previously been met with resistance, the team believed that creating radio programs to reach out to women and men alike would initiate positive dialogues about these concerns.

Additionally, the team collaborated with communications students from URACCAN. Young university-educated men and women expressed their desire to break down the cultural stigmas that prevent women from speaking out against violence and seeking help for health issues. The UVA and URACCAN students thought that creating programs voiced by university students and first aired on the university radio station would be particularly effective to overcome cultural taboos. This is because young adult involvement can demonstrate to the broader community that the next generation of leaders views this problem as a detriment to society that should be addressed and minimized. Furthermore, their willingness to present issues surrounding the well-being of women in a public forum via radio demonstrates that cultural taboos may already be decreasing among university students. This local partnership was essential to the success of the project as “the local community is a real world site in which community members and academics pragmatically determine whether the work is making a real difference, and whether the neighborhood and the institution are better as a result of common efforts” (Jacoby, xiii). Thus, by collaborating with ten students and their professor from the communications class, the team hoped to maximize the radio programs’ effect and longevity in the community. Their skills in radio programming and passion for the women in their community will allow women’s radio programs to continue being developed and broadcast even when the UVA group is no longer involved. The equipment provided will be especially helpful in this aspect because much of URACCAN’s materials had been ruined and would be replaced by the project funds. This will allow the project to continue and grow by increasing the range of women reached by the radio programs. Collaboration on this project has inspired URACCAN students to develop additional women’s radio segments and the class, along with a communications professor, is currently working on a film documentary about women’s lives in Bluefields.
Approach

The format and content of the radio programs were determined after conducting group and individual interviews with Bluefields women and URACCAN students of both genders in Summer 2010. While the team completed background research in preparation for this trip, it was learned that there was little relevant data or statistics which could give them a great sense of the issues really affecting the community. The members determined that the most valuable information gathering would have to occur during the actual time they spent in Bluefields, when they could learn about the community’s needs from community members through interviews. These interviews were conducted very openly and informally, and were more or less free of form. The team came prepared to every interview with a set of general questions, but introduced the project and let the women being interviewed guide the discussion with the information they thought would be most helpful and relevant to the team’s research. Since the primary languages spoken in Bluefields are Spanish and Creole, the team developed consent templates in both Spanish and English. Key informants and interviewees were solicited on a voluntary basis through community connections. They were read consent procedures in Spanish or English and their verbal responses were tape-recorded. Specific questions included individual and group perceptions of women’s status in Bluefields society, the most pressing issues related to women’s well-being, the best means of disseminating information to the community, ways women could be empowered by information and their personal experiences or observations about sexual and domestic violence in the community.

Through these interviews, the team gained a better understanding of community gender norms and issues surrounding violence and health in the RAAS. The questions posed in interviews with the community members focused on ascertaining the informational needs of women. Interviews and meetings with the URACCAN students focused on how to best disseminate information to women. After the interviews with various women, key informants and students, the group reviewed interview transcripts and notes to establish common topics, themes and information deficits identified by multiple community members. This method enabled the team to determine which topics to focus on in the radio programming. In meetings with the URACCAN students, the structure and number of radio programs were determined and research, writing and recording responsibilities were assigned to the UVA and URACCAN teams. The URACCAN students, who all major in communications and have gained significant knowledge about the formats of successful radio campaigns through practical experience and their studies, determined that a combination of longer radio segments and PSAs should be developed to address the multitude of issues women in the community identified as important. The UVA team assumed primary responsibility for researching topics such as breastfeeding, sexual health, domestic violence awareness and prevention, and pregnancy health. The majority of this information was gathered from the Centers for Disease Control and World Health Organization websites (Centers for Disease Control, 2011; Office on Women’s Health, 2011; World Health Organization, 2011). Additional sources included pamphlets available at the comisaria, the female-run police unit that handles cases involving violence against women and children, and IXCHEN, a non-governmental
organization that strives to promote and defend women’s sexual and reproductive rights while also providing a variety of affordable services for women. The team then organized the information on a blog in both English and Spanish in order to inform as many people as possible about these issues, in addition to compiling the information for the URACCAN students who formatted the actual radio pieces and recorded them in Spanish and English. One team member returned to Bluefields in January 2011 to follow up with URACCAN students and faculty.

Another component of the project involved importing new equipment from the United States to URACCAN’s radio studio in Bluefields, which had been affected by an electrical storm in 2009. URACCAN’s communications professor researched radio transmitters, laptop computers and microphones and provided the UVA team with his recommendations for the equipment that would best serve the university’s radio program. Although a laptop and microphone have been purchased and delivered to URACCAN, the team is still working with URACCAN to finalize plans to purchase the remaining radio equipment.

**Results**

The research conducted by the team while in Bluefields provided its members with a sense of what local women with a diverse range of experiences and backgrounds felt would be important to focus on in the radio programs. One key informant explained that interviewing victims of domestic violence and promoting higher self-esteem for women would contribute to the success of the radio programs (personal communication, May 27, 2010). She explained that programs emphasizing the unacceptability of domestic abuse and the value of women in the community would remind men and women both that women should be treated with respect (personal communication, May 27, 2010). Many key informants also stressed the importance of informing women in the community about multiple options of pregnancy prevention (personal communication, May 28, 2010). Women at the comisaría expressed their belief that domestic violence should be addressed and stressed the importance of informing victims of local sources of support, treatment and refuge. Members of the nursing school confirmed that violence, cancer and family planning are some of the largest issues facing women in Bluefields (personal communication May 31, 2010; personal communication, June 1, 2010).

Each community member’s unique viewpoints and opinions allowed the students to compile a diverse range of topics to be covered on the radio. The communications class at URACCAN was then able to incorporate interview results and outside research completed by the group into radio scripts with plans to create PSAs and longer radio shows that address the topics of domestic violence, sexual assault, breast cancer and planificación. Unfortunately, although the team had hoped to be able to share the interviewees’ feedback with the rest of the community through these radio spots and longer shows, most of the work was lost due to the destruction of much of the university’s radio equipment in a power surge in October of 2011. The URACCAN students hope to be able to recover the radio spots and play them on the air in the near future so that local women can benefit from them. Luckily, two six-minute radio programs, one for adolescents focusing on identifying and addressing unhealthy relationships, and one educating women about
the prevalence of domestic violence, were completed prior to the power surge and have since been aired on multiple radio stations in Bluefields (URACCAN Students of Intercultural Communication, Fall 2011a; URACCAN Students of Intercultural Communication, Fall 2011b).

Discussion

Despite the fact that the results of this inter-university collaboration cannot be directly measured, and that much of the initial work was lost in the power surge, the team still believes that it has had, and will continue to have, several positive impacts in the Bluefields community. The lack of equipment has made it harder to truly judge the impact of the radio programs in Bluefields because it is hard to determine how many women the information is actually reaching. Through the interview process, local women had the opportunity to discuss important issues that affect their community and ways to address them. They were also given the chance to truly talk about some of the problems that they see facing women in their community. The environment provided for the interviews – a nonthreatening, personal and informal space – allowed the women to share their true feelings and in some cases personal stories dealing with the issues facing women such as domestic violence, sexual violence and health related issues. However, that being the case, there is always a chance when talking about these issues that some women will feel uncomfortable and unable to share their true opinions and stories. Based off the information that the group received from the interviews this does not seem to be the case; the women were very open in sharing and very candid, yet it should be recognized that in any interview situation, there is a chance that information will be withheld. This could have been overcome by making the interviews more private. Most of them were held in semi-public places such as restaurants or our interviewees’ place of work. Spaces like these often do not make people as comfortable so formatting the venues in which the interviews were conducted could have helped to alleviate any worries that would have caused women to withhold information.

The JPC project also allowed the team to support the communications and radio program at URACCAN. Many of the students and one communications professor in particular, Jesus Salgado, are dedicated to women’s health and the education of local women and girls through radio. The addition of a new laptop, microphone and other radio equipment to replace what was destroyed by the power surge will allow the class to continue producing women’s radio programs that directly impact the project’s target audience, and to expand the scope of their capabilities in radio. As members of the Bluefields community with experience in the field of radio, these students and their professor are best-qualified and most knowledgeable about local problems and how to address them through radio which is why the partnership between the groups has been such a vital part of the projects’ success.

Ultimately, the team faced some major limitations, the greatest being lack of communication with its community partners. Despite their best efforts, the team members were rarely able to stay in touch with them when not physically in the city of Bluefields. Video and phone conferences were often disrupted due to connectivity malfunctions. The URACCAN student who com-
municated with us via email was only able to respond sporadically to our questions and reports. Although the team was able to accomplish most of the planned work while on site, it was difficult to remain updated on the status of the project between the trips in May 2010 and January 2011. Because of this breakdown in communication, the team was unable to have a sustained presence in the project during the fall semester. Fortunately, in January 2011 the team learned that although the initial work from Summer 2010 for the spots and radio programs was placed on hold due to the loss of equipment, the students and Professor Salgado have continued to work on radio programs focusing on women’s health. Additionally, several of the radio segments were actually broadcast in the past several months. Without the genuine and extensive investment in the promotion of women’s health and the education of local women by members of URACCAN, this project would have been short-lived and would have had little, if any, lasting impact on the community.

When the team undertook this research project, its members hoped they would learn about the topics and issues important to women in Bluefields from the women themselves. During the interview process with local women many common concerns arose. Almost every woman spoke about the need to prevent domestic violence as well as the importance of educating teenagers about reproductive health and pregnancy prevention, which came as a surprise to the group. According to local women, the concerns that the team had initially identified, such as domestic violence, family planning, HIV testing and breast feeding affect not only women, but also teen girls in the community, many of whom do not realize that pap smears and birth control are relevant to them as well (personal communication, May 28, 2010). Many interviewees expressed less concern about themselves than about future generations, hoping that education could prevent their daughters from perpetuating the cycles of single parenthood and domestic violence (personal communication, May 29, 2010).

When a group member returned to Bluefields in January 2011, she learned that a coalition of students and professors at URACCAN had begun work on a series of hour-long radio programs aimed at teaching adolescent girls about reproductive health and topics such as birth control, hygiene and their developing bodies. This is exactly the type of educational campaign that is needed in Bluefields and represents the start of more dedicated attention to local women by directly addressing concerns expressed to the team throughout the interview process. The local students’ and professor’s devotion to developing programs related to women’s health makes the team members confident that its research project has had a positive impact on the community.

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A Study of the Feasibility of Creating a Ceramic Water Filter Factory in Limpopo Province, South Africa

By Molly Tyeryar, Jack Reed, Caroline Hackett, Meredyth Gilmore, Lydia Abebe, and Alukhethi Singo

Abstract

In the summer of 2010, a Jefferson Public Citizens team traveled to Thohoyandou in the Limpopo Province of South Africa to conduct a feasibility study for building a ceramic water filter factory there. The region suffers from high incidences of HIV and of diarrhea resulting from waterborne illnesses. Membrane filtration and turbidity tests of water samples from over 200 households in two rural communities reveal that only 3.9% meet World Health Organization standards. An in-home survey about current water practices and water beliefs was administered in these homes. Participants ranked the desired traits of a water treatment technology and results suggest that ceramic water filters would be a socially acceptable solution for members of the two rural villages. These filters are a simple, effective, easy to use, and easy to maintain technology that can be locally manufactured with available resources. The team investigated willingness-to-pay for water treatment and for the filters. Over 96% of participants would be interested in buying a filter. The availability of raw materials was determined and clay sample analysis has begun. The team interviewed possible potters with whom to partner and chose the most suitable candidate. Initial contacts were also made at the municipal Department of Health and government health clinics to explore opportunities for filter subsidies, filter promotion, and water-health education programs. Based on the positive results of the project, several members of the group plan to continue their work and return to the region to facilitate the creation a ceramic water filter factory.

Introduction

Approximately 1.1 billion people do not have access to an improved water supply (Watkins). The World Health Organization defines an improved water supply as a household connection or access to a public standpipe, a protected well or spring, or a source of rainwater collection that provides at least 20 liters per person per day and is available within one kilometer of the person’s home (WHO/Unicef, 2000). Unimproved water supplies often contain waterborne pathogens which can lead to gastrointestinal infections, dehydration, stunted growth, cognitive impairment, and death. The United Nations estimates that, at any given time, patients suffering from waterborne diseases occupy about 50 percent of all hospital beds in the world (United Nations, 2006). Unsafe drinking water results in the deaths of about 1.9 million people annually (Watkins). Because diarrhea inhibits nutrient absorption, waterborne diseases can also lead to malnutrition, which causes impaired cognitive development, stunted growth and leaves children more susceptible to malaria and other enteric diseases (Petri et al., 2008).
Inappropriate, unsustainable technologies and systematic corruption in both donor agencies and recipients have done little to address these costs of unclean water. Decades of large-scale development projects have failed to deliver on promises of adequate sanitation and water services for 42 percent of the world’s population (WHO/Unicef, 2005). Progress on improving water sources is misleading as water may be re-contaminated during collection, transport, or storage, particularly in communities without thorough hygiene education. As climate change drives decreasing river water levels in some areas, turbid water and contamination during extended storage time becomes more frequent. Making any advancement in the delivery of potable water and improving health outcomes for underserved populations depends on the introduction of sustainable, scalable solutions. These technical solutions must prevent contamination not only at the source but also inside the household before consumption for a large, economically-challenged customer base. The team’s ultimate goal was to provide consistent access to potable water at the household level in a way that is financially and environmentally sustainable and scalable to other communities, and to provide income opportunities for target populations.

Limpopo Province, South Africa, the location of this study, has the fourth largest population in South Africa with 4 million people, but it has the third lowest number of households with access to piped water. Only 32 percent of children in Limpopo Province have access to an improved water source. Through a longstanding partnership with communities near the city of Thohoyandou and with the University of Venda (UNIVEN), the team compiled preliminary research data that justify an exciting opportunity to develop an environmentally and financially sustainable, scalable ceramic filter factory business. The low-tech, low-cost, colloidal silver-enhanced ceramic water filter (CWF) can provide a point-of-use solution to the health burdens caused by unclean water.

A recent review of the literature sponsored by the World Health Organization concludes that simple, socially acceptable and low-cost interventions at the household (point-of-use) and community level have the potential to significantly improve the microbial quality of household water and reduce the risk of diarrheal disease and death, particularly among children (Clasen, Nanda-katti, & Menon, 2006). In a recent meta-analysis of water-quality interventions aimed at reducing diarrheal disease, Clasen et al. (2006) report that household water interventions are more effective in improving water quality than interventions at the source and that household water treatment can be more cost-effective in the long run compared to centralized water treatment.

One of the most promising point-of-use water treatment technologies is the ceramic water filter, manufactured with local labor using clay, water, and a combustible organic material (such as sawdust or flour). When the clay filter is fired in a kiln, the sawdust (or other combustible) is burned out, leaving tiny pores through which the dirty water flows. This filtration process physically removes suspended sediment and larger microorganisms. Zero-valent silver nanoparticles (10-100 nm diameter) are also embedded in the porous ceramic filter, and have been shown to improve treatment performance by disinfection (Oyanedel-Craver & Smith, 2008). The pot-shaped filter is placed in a larger, plastic container with a spigot to also provide a safe-storage reservoir. Two recent studies have reported that these filters can effectively remove E. coli bacteria and turbidity from water (Kallman, Oyanedel-Craver, & Smith, 2010; Oyanedel-Craver
Pathogenic strains of *E. coli* can infect human gastrointestinal systems and result in diarrhea and dehydration. The removal of *E. coli* is a good indicator that the filter is effectively purifying the water, since *E. coli* is similar in size to other waterborne bacterial pathogens; if the filter can remove *E. coli*, then it is likely removing other bacteria and larger protozoan pathogens. It is important to also remove turbidity because some pathogens tend to adsorb to particles.

Filter factories are gradually spreading throughout the developing world thanks to the efforts of several non-governmental agencies like Potters for Peace and FilterPure. In a recent study of global filter factories, Rayner (2009) reports there are 35 established filter factories in 18 countries and filter production at these factories exceeds 40,000 filters per month. There are currently a few factories established in Africa, including factories in Rwanda, Kenya and Ghana. However, there are no CWF factories in South Africa or surrounding countries.

The team sought to determine the feasibility of starting a CWF factory to serve Limpopo Province, where reliable access to purified water remains limited. The proposed factory, as envisioned by the team, will be added to an existing pottery business. It will use local labor and primarily local resources. This factory will be built on a bottom-up approach, informed by input from community members collected through an in-home survey and interviews with community leaders, clinic managers and officials in the municipal Department of Health. The team investigated the feasibility of the factory from four different angles: human health benefits, technological performance, demand-side economics and supply-side economics. They also evaluated social acceptance and perceptions, critical components of any community engagement project.

**Methods**

The team approached the search for a scalable, point-of-use household water treatment system from an interdisciplinary perspective. The team developed and conducted a survey about water perceptions and willingness-to-pay for two rural villages in Limpopo Province. Household water quality was evaluated in over 200 homes. Regional non-governmental agencies and government health clinics were identified as potential customers for the filter factory. Finally, local potters were interviewed as possible candidates to host the filter factory.

A 50-question survey was developed by the team in conjunction with faculty advisors from the University of Virginia and the University of Venda. The survey contained questions that, after analysis, would help the team determine if moving forward with the construction of a factory was warranted. In order for any business to be successful, there must be a need demonstrated by the consumers for the product being sold. There are many point-of-use water treatment options, ranging in sophistication, expense and ease of use, so it was necessary to determine if CWFs are the best possible solution for the consumers in Limpopo Province. The product that will be marketed must be a proven solution to the problem and socially acceptable to the communities of the region. Keeping all of these factors in mind, the team developed a survey that focused on water beliefs, water storage and treatment practices, desirable traits in a water purification tech-
nology and perceptions of proposed clay water filtration technology. Questions also included general demographics and income questions to help determine consumers’ ability to pay. The survey was given to participants in two rural villages, Tshapasha and Tshibvumo, which take part in a long-standing relationship between the University of Virginia (primarily through the Center for Global Health) and UNIVEN called the Water and Health in Limpopo Project. Surveys were conducted when an adult member of the home was available. In-country student partners, who are nursing students at the University of Venda, facilitated communication. GPS coordinates were taken from every home, to make sure all areas of the villages were represented. The UNIVEN partners complete community outreach in the villages as part of their nursing curriculum, and were therefore familiar with the geographical area and the community members. They made sure that areas farther from water sources were included in the survey so as to get a complete sample of village residents’ opinions.

A drinking water sample was collected from every home surveyed in Tshapasha and Tshibvumo. The survey administrator asked the survey participant to bring a sample of water from the supply that is used for drinking. Most often the sample came from a storage container inside the home or from a pipe in the yard. The participant was asked to collect the sample in whatever vessel he or she would normally use. Stored water can be further contaminated by using an unclean vessel or if unwashed hands or containers are used to retrieve the water. By asking the household member to access the water in the usual manner, the team could measure the amount of contamination that is entering the body due to unhygienic water practices. The water sample was kept in a cooler for the duration of the time spent in the village and during transport to the Microbiology Laboratory at UNIVEN.

The samples were subjected to a membrane filtration test in which five mL of the household sample were diluted to 100 mL and passed through a sterile 45-µm membrane filter (Millipore). The membrane was placed in a Petri dish prepared with m-Coliblue24 broth or Eosin Methylene Blue (EMB) agar and incubated at 35 °C for 24 hours. After incubation, the number of *Escherichia coli* (*E. coli*) and total coliform colonies were counted and the results were reported as the number of colony-forming units per 100 mL. Some samples contained too many colonies to count, and were further diluted with deionized water and retested. The turbidity of the sample was also recorded using a turbidimeter.

Through talks with one of our community partners, Professor Maluleke of the Nursing Department, and information from other community members, the team came to recognize the importance of the health clinics in the community and the role they play in health education. The team became interested in investigating possible collaboration with and distributions through the public clinics. Professor Maluleke suggested seven local government clinics as a representative sample of public clinics in the region. Informal interviews were conducted with the clinic directors to gauge their willingness to become an integral part of the education and marketing that is necessary for the successful distribution of the CWFs. The interviews included questions about: the average number of patients seen a month, how many and which villages the clinics served, number of doctors and their frequency at the clinic, number of nurses, percentage of
male and female patients, education levels among patients of different ages, common ailments and incidences of diarrhea. The team asked about the clinics’ education programs and whether they included information on water purification and safe practices. The team also inquired about the home-based care workers who made house calls in the villages. Some clinics could provide more specific information about the water sources and water purification methods used in the communities they served. The investigators explained the CWF project and attempted to gauge the effectiveness of the clinic as a marketing and education source for the factory. Initial contacts were also made at the municipal Department of Health. These meetings, although brief, were promising that a future partnership involving subsidies, education, distribution and/or marketing could move forward.

For the supply-side component of the feasibility study, the team investigated sources of materials for the factory and also reviewed possible partner potters. The materials investigated include: plastic buckets, clay, sawdust or other combustible material, spigots and colloidal silver. Inquiries were made at building supply stores in the city of Thohoyandou and along the main business corridor outside of the city. Sawdust can be cheaply obtained at local hardware stores. Clay is locally harvested by potters. Local potters were identified by a community contact and visits were made. Criteria for selecting a potter included: ease of distribution from the potter’s existing facility, size and sophistication of the potter’s facility, amount of pottery skill and experience, connection to and support from the community, number of employees, interest in community health, business skills and potential for expansion.

Clay samples were collected from each potter’s source, which often included both wet and dry clay which were mixed together for use in pottery. The clay samples were brought back to the Civil and Environmental Engineering Laboratory at the University of Virginia for analysis. The analysis seeks to find the optimal mixture of the sample clay with sawdust and water to produce the CWFs. The analysis involves fabricating ceramic test disks from the clay and testing them for hydraulic conductivity using a constant head permeameter test and for microbial transport.

Results

A portion of the in-home survey was used to determine the relative importance of various characteristics of a water treatment technology within the community. These characteristics included: water quantity, ease of use, cost, local availability, taste, coloration and odor of treated water and supply chain. The community determined that local availability was most important and quantity filtered was least important. Several different treatment options, including CWFs, free chlorine treatment, coagulant/flocculant treatment, solar disinfection and biosand filtration were scored on the aforementioned characteristics using the rankings listed in Sobsey (2008). Based on the importance rankings from the market survey, the CWF was selected as the most appropriate point-of-use technology, with biosand filters as a close second.

When asked if they would be interested in buying a ceramic water filter, 96.3% (184/191) of the participants who answered, responded ‘yes’. Ninety five and six tenths percent of participants
said that if filters were to become available they would buy one either immediately or within the next six months. The most common reason participants answered “within the next six months” was to allow for the expense to be added to the household budget. Willingness-to-pay answers revealed that the average participant would be willing to pay around $13 for a ceramic water filter. This result is inconsistent with the average amount households are willing to pay on a monthly basis for water purification technology, which is a little under $10. These payment responses, coupled with the need to budget, lead the team to believe that an expensive purchase during one month is less attainable for a household than smaller monthly purchases. This may be due to a lack of understanding the life of the filter or the life of comparative products available to the households.

Results show that 99% of participants store at least a portion of their drinking water until needed. Though 77% keep these storage containers covered, 72.6% obtain the water from a storage container in a way that could lead to contamination of the stored water, such as dipping a cup or other container into the stored water. Even small amounts of bacteria in the stored water may multiply over a short storage period. The majority of survey participants, 99.4%, know that diarrheal incidence will decrease if they get clean water and store it in a clean container in a way that does not lead to contamination.

Results demonstrated only 8 of 205 (3.9 %) water samples collected from households met WHO standards. The WHO’s standards for safe drinking water are < 1 colony forming unit (CFU) of coliform bacteria per 100 mL of water. The average of the water samples tested as a part of the survey was over 1800 CFU/100 mL. The standard for *E. Coli* is also < 1 CFU/100 mL. While 66.5% of households meet this standard, the combination of these numbers clearly shows a need for water quality intervention.

After meeting several local potters, the team made a preliminary selection of Noria Mabasa, an entrepreneurial potter who has been recognized by the South African government for her innovative work in the region. The team decided that it was best to partner with a potter who is already successful and who has sufficient access to resources in order to ensure the success of the factory and the greatest benefit to the community. Mrs. Mabasa will hire workers and sustain the factory for many years after construction is complete, providing filters for thousands of families. Mrs. Mabasa has access to a clay deposit, which she uses for her pottery business. Clay analysis is ongoing to determine the water to clay to sawdust ratio needed to make CWFs with the appropriate flow rate.

**Discussion**

Filter factories are gradually spreading throughout the developing world, with 35 established filter factories in 18 countries. Despite these successes, many filter factories fail to remain profitable and sustainable. Several factors likely contribute to failure, including lack of local interest in water purification technologies; lack of local NGO support; lack of a local entrepreneur with resources and skills to start a factory with appropriate understanding of how to operate a
local business; and lack of natural resources (e.g. local clay deposit suitable for manufacturing ceramic filters). The limitations outlined above were addressed by this project, and the results give us the confidence to move forward with the construction of the ceramic water filter factory. Although there are significant limitations to the success of a ceramic water filter factory, we believe we have appropriately assessed the potential for success. Our assessment shows that the factory is necessary for the health of the community and likely to be successful. Based on home survey responses ranking the desired characteristics of a water purification technology, the CWF is the most appropriate technology for the region. The community has demonstrated an awareness of the connection between clean water and health, but lacks the resources and infrastructure to achieve those things. The ceramic water filter is a simple, effective, easy to use and easy to maintain water treatment technology that lasts for about two years. CWFs can be manufactured and sold locally in Limpopo Province by a manufacturer with community connections. The business can be promoted through water health education programs run by government clinics and non-profits.

A ceramic water filter factory can initially employ two full-time laborers. These employees can manufacture approximately 1000 filters per month that can sell at a rate between $10 and $25 per filter, including the plastic safe-storage container with a spigot. As explained above, surveyed households have an average willingness-to-pay of around $13, which is in this range. Possible partnerships with the Department of Health and in-country NGOs may result in subsidies that will allow distribution to families in the lowest income bracket. Monthly payment plans may also be considered. Filter sales will result in a monthly gross income between $10,000 and $25,000 per month. Filter raw materials only require transportation costs for the clay and sawdust, and a cost of less than $0.50 per filter for silver treatment. Other projected operating costs include advertising and fuel for the kiln. Capital costs include expenses for a kiln, filter press, hammer mill, thermistors (for better temperature regulation of a kiln), inventory storage and sieves. The current estimate on the total for these capital costs is $30,000. Production costs of each filter are estimated to total about $8. A cash flow model with estimates of input costs reveals that in order to recoup initial investment within the first year, filters would have to be sold at a price greater than $10.50. If filters were sold at $13 per unit, the average willingness-to-pay, the factory would have a net income (after subtraction of initial capital costs) of about $25,000 in the first fiscal year. With the life of a filter being 2-3 years, there will be a continued supply of customers every year based on when they make their first filter purchase. Ideally, we envision the Limpopo factory to be a pilot, with the potential of developing dozens of additional factories in South Africa throughout the rural countryside.

Now that the high potential for success of a CWF factory has been established, the next step towards bringing a clean water solution to the Limpopo Province will be to construct the factory. Equipment including a hammer mill, sieves, filter press and drying racks must be purchased. A kiln must be purchased or constructed on site. Marketing must include reaching out to local NGOs, the municipal government, health clinics and schools. Collaboration with government and community health programs on promoting a water and health curriculum will be essential to
ensuring that the community recognizes the benefits that purified water will bring. Pamphlets and presentations must be put together outlining the importance of safe water practices and the role of CWFs. Further clay analysis must be done at UNIVEN to finalize the optimal clay/combustible/water ratio for use in the filters.

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References


Biographies

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Narrowing the Digital Divide:  
The Young Women Leaders Program  
*HerStory* Project

By Stephanie Newton, Emily Peters, Victoria Tucker, Christine Quilpa,  
Edith Lawrence, and Clare Vierbuchen

**Abstract**

Research suggests that low-income girls are at a special disadvantage in the field of technology and are less likely to take courses or seek out careers in technology. The HerStory project uses an established mentoring program (The Young Women Leaders Program) and accessible, collaborative technology projects to engage middle school girls in technology. This study reviewed, revised and evaluated the HerStory mentor training and curriculum. Findings indicated that curriculum revisions seemed to improve girls’ engagement in technology projects, while modifications to mentor training improved the mentors’ grasp of relevant technology. Notably, girls frequently had experience with more basic technology, such as taking digital photos, but reported having less opportunity to use more complex technology, like editing audio and video. While the girls expressed interest in technology, it seemed that limited access and experience may play a strong role in distancing them from this field.

**Introduction**

Middle school is a critical period in girls’ lives as they make the transition to high school and determine the direction of their future academic and vocational careers. Performance in middle school classes begins a trajectory that can either narrow or expand girls’ options for college. A subset of middle school girls, particularly those with significant environmental stressors (i.e., poverty, single-parent family), is at greater risk for educational failure, school dropout and involvement in delinquent activities (Eccles, Roeser, Wigfield, & Freedman-Doran, 1997). More recently, Coie and Miller-Hohnson, proposed a developmental model that emphasized the correlation between early peer rejection and child delinquency (Howell, 2003). Furthermore, he notes that early signs of delinquency have important implications for individuals’ life-course involvement in crime. In addition to other disadvantages they face, low-income youth are less likely to have access to computers or informational technology. This lack of access to technology creates a “digital divide” that widens as youth progress into high school (Matwyshyn, 2003). The digital divide is compounded for low-income girls in particular, since research shows that girls are already at a disadvantage in the field of technology. Studies indicate that women and minorities are less likely to take high school computing courses than white males (Epstein, 1993). However, researchers focused on addressing this divide have found that teaching computing and information technology in a way that builds on the interests and needs of women and
minority students can increase technology's appeal to these students (Cohoon & Aspray, 2006). Furthermore, more recent studies show that females have more positive attitudes towards using technology when they learn in cooperative groups (Spector, 2008).

Teaching technology within a mentoring program may be one way of closing the digital divide for adolescent girls. Studies have found an association between mentoring relationships and positive outcomes for youth, including reduced drug and alcohol use, better peer and family relationships, improved academic performance, attitudes, and behavior, and an increase in the likelihood of attending college (Dubois & Karcher, 2005). Unfortunately, there is little research on the value of using mentoring as an avenue for directly addressing the digital divide for low-income adolescent girls.

The Young Women Leaders Program. The Young Women Leaders Program (YWLP), an established after-school mentoring program for at-risk seventh and eighth grade girls, uses a combination of one-on-one mentoring and targeted group activities to empower girls to be leaders (Lawrence, Sovik-Johnston, Roberts, & Thorndike, 2009). The research-based group curriculum and sustained weekly mentoring relationship with a college woman cultivates the girls' competence, connections, autonomy and supports their academic, social and emotional development. Since 1997, YWLP has mentored over 1,000 middle school girls and trained over 1,000 college women mentors.

In 2007, UVA faculty and students developed a curriculum that would engage at-risk girls for a second year of mentoring. The YWLP HerStory project focuses on increasing eighth grade girls' confidence and skills using computer technology. The curriculum is designed to extend the successful seventh grade mentoring program by offering the girls a second year of mentoring, specifically focused on the applications of computing and informational technology to their lives (i.e., digital storytelling, digital animation). A pilot of this curriculum implemented in 2008 with a small number of at-risk girls supported the hypothesis that digital storytelling can be an innovative entry point for increasing girls' interest in information technology (Newton, et al., 2010).

Overview of Current Curriculum and Improvements Made from Previous Years

The primary objective of the YWLP's HerStory project is to introduce technology to eighth grade girls within the context of a supportive mentoring relationship. At-risk girls are individually nominated for the program by their teachers, guidance counselors and school administrators as young women who show leadership potential. Each of these girls (Little Sisters) is paired with a female college mentor (Big Sister). Mentor-mentee pairs meet individually outside of school four hours a month, but also meet with a group of five to eight other pairs for a two-hour weekly meeting. During group time they follow a structured mentoring and technology curriculum focused on using technology as a platform to support girls' leadership development. The curriculum introduces various critical issues faced by adolescent girls at home, at school and in their community. The girls are then encouraged to relate them to their own lives. Individually and in the group, the mentors help their mentees use various technology platforms to create a digital story about themselves and/or an issue of particular importance to them. The focus may be their...
family, a recent loss or a common concern for girls in middle school. During the first semester, the girls develop a technology project using the program PhotoStory, a digital storytelling program that allows users to create a slide show using photos, voice recording and music. During the second semester, video recording as a technology platform for telling a story is introduced. The girls use flip video cameras to film the story of a woman leader from their community or to introduce an issue they feel is important to adolescent girls in their community. Flip Cams are palm-sized video cameras that can record, zoom and playback video instantly through simple application. The girls then use video editing software to create a short film about their topic.

**Current Project**

Despite the improvements to the *HerStory* project’s design and curriculum made by last year’s Jefferson Public Citizens (JPC) team, feedback from mentors and mentees revealed areas still needing improvement. Previous changes resulted in higher project completion rates than the year before, but feedback indicated that both mentors and mentees found portions of the curriculum boring and difficult to complete. Thus, the focus of this year’s JPC project and this study was to use this feedback to improve the curriculum so that participants were more likely to complete their technology projects and thereby increase their sense of mastery using technology. In particular, we focused on making the technology curriculum more engaging for adolescent girls and revising the mentor and facilitator training on the use of the various technology platforms so that they felt more prepared to teach the technology and support their mentees in its use.

**Methods**

Using feedback collected by last year’s Jefferson Public Citizens team and the team’s own research over the summer, the mentoring curriculum and mentor training were revised. Revisions focused on increasing girls’ engagement in the curriculum and their investment in their technology projects. Over the course of the academic year, a revised curriculum was implemented with 29 eighth grade girls at four middle schools in Charlottesville, Virginia. Training for mentors and facilitators was also revised and the team trained 27 mentors and eight facilitators in the relevant technology at the beginning of each semester.

In designing the curriculum for this school year, the team used qualitative and quantitative data collected from past participants to inform revisions. This data was comprised of surveys and interviews with YWLP contact staff from participating middle schools and with college faculty and graduate students involved with the YWLP. The team then evaluated the new curriculum’s effectiveness in engaging the girls in specific technology projects, while increasing their skills in computing and informational technology.

In addition to changes in the technology components of the curriculum, the team also revised the non-technology activities to better reflect the girls’ desire for increased group activities that address their concerns in eighth grade and their desire for more community service engagement. The modified curriculum covers specific topics such as goal-setting, academic success, conflict resolution and peer group issues; all areas that are important in middle school and as a foundation for next year’s transition to high school. Special attention was also paid to the
issues identified as needs by school personnel including body image, emotional regulation and confidence building. The revised curriculum also includes several projects that allow girls to extend their abilities as student leaders and active citizens within the Charlottesville community. Other projects had a more global focus and helped connect the girls with girls and women from another country through letters, e-mails or online chatting. Finally, the team introduced a number of guest speakers into the curriculum, including teachers and community role models.

To evaluate the revised curriculum, a combination of quantitative survey data as well as individual and group interviews was used. A survey assessing participants’ exposure to and attitudes towards technology was administered three times over the course of the year: once at the beginning of the mentoring program, once at the end of the first semester and once at the end of the second semester. Twenty-three mentees completed surveys once before beginning their technology projects and again after completion of the first semester. The team also developed an interview protocol to be used with mentors and mentees at the end of each semester’s curriculum. These interviews included individual interviews with the middle school girls and focus groups with mentors. These interviews and focus groups covered overall experience in the YWLP program, as well as their evaluations on the use of technology and the curriculum itself. In December 2010, nine middle school mentees participated in individual interviews upon completing their technology project. In January, ten mentors and two facilitators participated in two focus groups on their experience with the HerStory curriculum and training thus far.

Finally, the team interviewed a middle school technology teacher at each of the four schools to better understand mentees’ exposure to technology in school and the technology skills needed for their class projects.

Results

Qualitative Findings

Mentee Interviews. The middle schools girls that were interviewed all expressed appreciation for the different aspects of technology they learned. Many were especially appreciative of the use of a camera to document their time with their Big Sisters. One Little Sister remarked, “I learned that I like taking pictures more as artwork than drawing them, and I like to be in the pictures as well.” The use of the cameras was popular during the group setting, as well as during the time that the Little Sisters spent with their Big Sisters one-on-one. “I really liked using the cameras to take pictures of us playing around or just hanging out outside of group.”

The girls seemed to gain a better understanding of their own competence in using computer technology as well. As one Little Sister noted, “I learned that I am more independent than I thought I was. I feel more confident because of my PhotoStory.” The girls were able to use the pictures they took to tell a story that was important to them. Topics included their love of fashion and the type of clothing they wear, their favorite author, the country from which their family originated and its customs, and the special time they spent in YWLP. As one Little Sister noted, “The best part was letting everybody know that this was something that you have a passion for doing. It’s something that I like to do a lot, so I was really glad to share.”
In terms of the curriculum, the girls reported gaining a greater understanding of the use of technology, but had mixed feelings about some aspects of the technology programs. While some girls found the technology easy to use, others noted that it took more time than they expected to learn how to use the digital storytelling program, PhotoStory. Some girls shared that the hardest part of the project was “not feeling secure with the technology.” They also said that they would have liked to be able to spend more time on the project, to “add more details.” The girls said they liked that the PhotoStory program allowed them to use several different forms of media including music, photos and written comments on the slides: “It’s just like a slide show, but it’s cool because you can add recordings and such.” Girls also said they liked that their Big Sisters were learning the technology with them and offering support. “I learned how to use the different technology, but my Big Sister was always there and made sure I had help when I needed it.”

Some of the girls noted that learning technology was fun. In comparison to the seventh grade curriculum one said, “Last year we mostly talked, and this year we used a lot more technology. I like the technology better because we can talk and have fun, and use technology at the same time.” On a related note, the girls expressed interest in learning other computer skills outside of the PhotoStory program. For example, one girl said, “I’m not good at typing, but the more I use it, the better I could become.” Another Little Sister said she was interested in “using the computers more in general and learning other computer skills.” This girl also said, “My school doesn’t do a lot that involves technology, and we don’t have a photography class in middle school.” It appears that for those girls who do not have access to technology in the classroom or home, participating in YWLP provides a unique opportunity for technology exploration.

**Mentor Focus Groups.** Interviewing the facilitators and Big Sisters of the eighth grade program provided additional information on the pros and cons of the PhotoStory project. In interviews, they were unanimous in identifying the process of helping their Little Sister choose a project topic and execute editing details with the PhotoStory computer program as challenging. One Big Sister shared, “You wanted each Little Sister to have the creative capacity to choose topics of interests, but there was also a need to steer them in a direction where they could reach deeper.” Many said the process required shared input. In particular, they found it was helpful to brainstorm topic ideas with their Little Sisters, then narrow down the topic and, finally, identify its significance. This mutual problem solving facilitated the development of more personal PhotoStory topics. In addition, the facilitators and Big Sisters identified that showing the Little Sisters past PhotoStory projects as reference points was a useful strategy. By viewing these examples, the Little Sisters were able to connect their beginning steps with a finished project.

When asked about what environment facilitated completing the project, the facilitators and Big Sisters agreed that it was most productive when each Big and Little pair separated from the group and worked by themselves on their project. Spreading out across the school allowed for clearer audio recordings, decreased distractions and promoted Big and Little pair bonding. For those Big and Little pairs who were able to create quiet and reflective work spaces, there was a noticeable difference in the quality of audio presentation. In discussing the Little Sisters’ ability to operate the computer program, the facilitators and the Big sisters shared that the Little
Sisters were able to utilize this technology tool without complications. Additional suggestions highlighted the importance of breaking the project into more steps that might help pairs make steady progress on their project and avoid last-minute rushing. For those Little Sisters who felt the project was too much like a school assignment, the facilitators and Big Sisters found it helped to work on it as a pair during one-on-one time rather than in the large group sessions. For example, a Big Sister shared that instead of having her Little Sister take pictures on her own for her topic, the pair used the photo task as an opportunity to promote sister time by taking pictures out in the community. It appeared that the facilitators and Big Sisters needed to think creatively and be flexible about the project in order to engage their Little Sisters and meet the goal of a meaningful interactive learning experience.

**Interview with Technology Teacher.** The interview was conducted with a technology teacher who currently works in one of the county schools served by YWLP. His experience is not limited to students that feed into the county division, but also incorporates serving middle school students in the city district through extracurricular involvement. When asked about girls and technology, this teacher talked about the importance of involving girls in learning about technology and making it interesting in their lives. He noted, however, that there was relatively limited opportunity to do so within the school. Students learn basic skills, such as typing, as a part of the sixth grade curriculum, and seventh and eighth grade students are able to choose the technology course as an elective. Although he felt the elective course is successful and focuses on engaging students through interesting projects, not all students are reached by this course. For those who do take it, he felt the implementations were significant; students become familiar with and confident about using technology and can apply these skills to projects in other classes, including presentations, research and curricular projects.

The teacher emphasized that, in his experience, a number of factors can influence students’ “range of comprehension” when learning about technology. Students without regular home access to a computer are less likely to be able to type quickly, navigate the Internet or easily understand new software programs. Within this school, the teacher noted that “there is a larger population that does not have access to computers at home.” Enhancing professional skills with the use of technology not only contributes to academic success, but can increase confidence inside and outside the classroom. The teacher felt that, to this end, increasing students’ exposure to technology through programs such as YWLP could be highly beneficial (County technology teacher, Personal Communication, December 3, 2010).

**Quantitative Findings**

**Demographics.** Forty-three middle school girls from four different middle schools participated in this year’s *HerStory* project. The ethnic breakdown of the mentee group was: 56% African American, 27% Caucasian, 7% Hispanic and 10% other. Their mean age at the beginning of the school year was 13.5.

**Previous exposure to technology.** After completing an initial survey toward the beginning of the
year, it was apparent that mentees had varying backgrounds of exposure to technology. (See Table 1)

Almost half (47.6%) of the mentees surveyed had completed a previous technology class. Of those who completed a previous class, 60% had completed one year of technology classes, 20% had completed two years of technology classes, 10% had completed five years of technology classes, and 10% did not respond with the number of years in which they had completed previous technology classes.

**PhotoStory Completion.** To measure the success of the new curriculum in better engaging girls, we compared total percent completion of PhotoStory projects from last year to this year. In the fall of 2008, using the original curriculum, 14 out of 36 (38.88%) middle school girls participating in the program completed a PhotoStory project. In the fall 2009 program, using the revised curriculum, 26 out of 43 (60.46%) middle school girls completed their PhotoStories. Lastly, in the fall of 2010, 24 out of 29 (82.76%) middle school girls surveyed completed their PhotoStories. (See Chart 1)

**Discussion**

The *HerStory* curriculum was designed to increase girls’ knowledge, interest and confidence in the field of technology by using technology as a platform to allow them to express their views about an important issue in their lives. Creating a computer-generated product they could share with a larger audience allowed girls to develop a sense of competence and pride in their emerging technology skills. This study involved significantly revising the *HerStory* curriculum by changing content and structure with the aim of increasing mentee engagement. In addition, improvements were made to the mentor technology training in order to better prepare mentors for guiding mentees in creating their projects.

Findings show that the *HerStory* curriculum revisions were successful in improving girls’ engagement in projects. This year saw a significant increase from previous years in the total percent completion of fall projects. This year, 82 percent of Big and Little pairs completed their PhotoStory project, in contrast to 38 percent in fall 2008 and 60 percent in fall 2009. This finding suggests that changes to the curriculum better engaged adolescent girls and provided the framework needed to help them finish their projects.

<table>
<thead>
<tr>
<th>Variables</th>
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<tr>
<td><strong>Technology Access</strong></td>
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</table>
Revising mentor training in technology seems to have improved the ease with which mentors and mentees completed their projects. While last year’s mentor and mentee interviews described a number of technological difficulties, such as problems adding music to projects (Newton et al., 2010), this year’s feedback did not highlight any similar difficulties.

There are a number of possible explanations for why some pairs failed to complete their technology projects. Failure to complete a project could be linked to not feeling close or connected to their mentors. Not surprisingly, YWLP findings indicate that significant variation exists in the quality of mentoring relationships within the different eighth grade groups. HerStory storytelling projects involved sharing personal information first with a mentor and then with a larger audience. Mentees who felt less connected to their mentors might be more reluctant to work on such a project. This year, the curriculum was revised with the aim of improving the support and structure offered to the mentees in finishing their projects. Nevertheless, outside factors such as some girls’ poor school attendance and stress at home or in school could still make completion of the project difficult.

In terms of previous exposure to technology, girls frequently reported using more basic technology, such as taking digital photos. On the other hand, they described having less opportunity to use more complex technologies like editing audio and video. Though most girls had at least some exposure to a variety of technology formats, they had limited experience using technology as a platform for storytelling. The HerStory curriculum allowed these middle school girls to develop their abilities and interest in technology while benefiting from the help and support of older, more experienced college women. After completing the HerStory projects, girls reported that this supportive environment made it easier to learn unfamiliar technology and also reported an increased interest in continuing to use new technology.

Overall, findings support previous conclusions indicating that the middle school girls are interested in learning about technology and working with computers. Within the school environment, however, limited access and experience may play a strong role in distancing girls from this field. While the girls possess a desire to learn, many of them may not have the opportunity. Over half of the girls in the eighth grade group stated that they had not participated in a course in technology. Although technology courses are offered by some schools, offering these courses as electives, rather than as mandatory courses, may limit the likelihood that girls will be exposed to technology. A number of factors such as lack of confidence in their ability to learn technology, involvement in other activities and academic difficulties could prevent girls from participating in these courses.
Future Directions

This most recent revision of the *HerStory* curriculum has shown promising results so far. The evaluation of this new curriculum will continue until the end of this school year. Of particular interest is the relative success of the new video documentary projects in teaching and engaging mentees. The team will assess the middle school girls’ changing attitudes and familiarity with technology in an end-of-year survey and compare that to their responses from the beginning and middle of the year. Finally, to determine how the *HerStory* curriculum might be further improved, further interviews will be conducted with mentors and mentees at the end of the academic year.

References


Biographies

**Stephanie Newton** is a fourth year English and French major. She has been involved in YWLP for the past three years and has been a facilitator for the past two years. She is planning on moving to Washington, D.C. after her graduation in May.

**Christine Quilpa** is a third year student studying Sociology and Asian Pacific American Studies, and can be found around grounds taking part in various artistic endeavors. She has been involved with YWLP for the past two years.

**Victoria Tucker** is a third year student in the University’s school of nursing. She has been involved in YWLP for the past two years as a Big Sister and a facilitator.

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Got Milk?:
A Case Study of Gulu Women Dairy Farmers and Post Conflict Reconstruction

By Anna Conn, Kappie Farrington, Rachel Leeds, Sarah Munford, and Rae Blumberg

Abstract

War destabilizes a nation by uprooting the political, economic and social facets of society. Once a conflict has ended, great efforts must be made by state and local governments to restore stability and prevent the resurgence of violence. In order to ensure stability in a post conflict region, both social and market structures must be addressed (USAID, 2009). In this article, we seek to define and analyze the relationship between the social and economic elements of the reconstruction process. In particular, this team wishes to explore which social transformations impact the restoration of stability in a war-torn community. Moreover, to attempt to understand the unique role that gender plays in the rehabilitation of a society. In order to address these questions, the team will look at the approaches taken by community members and development organizations in the Acholi region of northern Uganda.

Introduction

The goal of this research is to better understand the role of livestock development groups and the advantages of applying a gender-neutral focus in the reconstruction of post-conflict society. In 1997, a group of seven women founded the Gulu Women Dairy Farmers Association (GWDFA) with the aim of providing a source of income security to dairy farmers in the northern region of Uganda. GWDFA was created in response to challenges caused by the devastating war between Joseph Kony’s Lord’s Resistance Army (LRA) and the Ugandan government which forced the displacement of approximately 1.8 million people into government-protected internally displaced persons (IDP) camps since 1986. As the LRA has moved into the Congo and Gulu has stabilized, many people in northern Uganda are moving home to begin reconstructing their devastated communities (“Update on IDPs Movement,” 2009).

Because recently-stabilized regions tend to fall back into conflict if economic insecurity persists, many governmental and non-governmental organizations (NGOs) are focusing their efforts on the stabilization of the pre-war economy (USAID, 2009). The Acholi economy is almost entirely based upon single-household agricultural production; therefore agriculture is central to expectations for future economic prosperity and development in the region. Many international initiatives target women because they comprise a large portion of the agricultural workforce and more equitably distribute spending of income (Blumberg, 2009). However, such focus has led to the systematic disempowerment of men and the dismantling of traditional power structures (Nabudere, 2009).
This research evaluates the success of GW DFA's gender-neutral model. Since 1997, the group has grown to include 54 families, though the size is constantly in flux. The organization has received 72 heifers since they partnered with Heifer International (HI) in 2004 and the HI extension staff has supported their education and training program as well. HI takes a unique approach to economic re-integration by adopting a holistic perspective to agricultural development. By involving both men and women in their programs, GW DFA and HI promote gender equality in the social and economic spheres of the community.

Methods

Methodological Approach

A participatory-action rapid appraisal approach was selected using the triangulation of several methods of data collection in order to maintain flexibility and cultural sensitivity. The team cross-referenced different experiences and encouraged community involvement. In designing these methods, a primary concern was the language barrier for which a translator was employed. Because the subject matter is sensitive and personal, research subjects were assured their anonymity.

Data Collection Tools

The team collected data through four methods: interviews, focus groups, photojournaling and observation. Most illuminating were the individual interviews. The interviews were fluid and adaptable to the subject’s interests, encompassing any or all of the following topics: family and gender roles, division of labor, his/her relationship with GW DFA, memories from the war, his/her thoughts about Heifer International (HI), and his/her opinions on the NGO presence in Gulu (see Appendix A for list of participants).

Originally focused solely on the female members of GW DFA, the team soon realized the value of understanding both male and female perspectives, and how they coincide or conflict. Interviews were intimate and informal, and restricted to the research team, a translator (if necessary) and the interviewee. A total of eleven members from GW DFA were interviewed individually, two of whom were men and also incorporated the male perspective through discussions in the men’s focus group, and interviews with the HI staff.

The second method used was focus groups. The team facilitated discussions during one of GW DFA’s weekly meetings in order to explore the dynamics between their members. There were four different focus group discussions (three groups of ten women and one group of thirteen men) which lasted approximately 45 minutes. Within the groups the members discussed gender stereotypes, the changing roles of men/women in Acholi society, whether or not they felt the war was the main cause of social and economic change, the importance of education, men and alcohol abuse, and the reconstruction and reintegration of communities in Gulu.

The team also gathered data through photojournalism. Six volunteers (three men and three women) were each given a disposable camera on the day of the aforementioned meeting, to be returned by the end of that week. The pictures were developed over the weekend and returned to their owners at the meeting on the following Tuesday. Members were prompted to photograph
images and scenes they felt were representative of Acholi culture and/or their role in GWDFAs (for more on “photovoice” and participatory action research, see Wang and Burris, 1997).

Consent was obtained for any personal photographs, and a concerted effort made to engage in a variety of cultural activities to enrich the research through observation and cultivate a more profound understanding of the Acholi lifestyle.

Data Analysis

This analysis is primarily based on the comparison of transcribed interviews and any notes taken during different conversations and experiences. After interviews, notes were reviewed to identify key information to include in the analysis. This included but was not limited to: statements which were repeatedly emphasized and/or ran counter to current literature on gender norms (Kyomuhendo, 2006; Tuyizere, 2007; Mulumba 2010), and new ideas that had not previously been addressed in other interviews.

One copy of each photograph taken for the photo journal project has been kept for potential use in presentations and papers. These photographs serve as representations of the GWDFAs members’ perspectives on life during reconstruction and their role in the group.

Results & Discussion of Findings

Agricultural, Economic, Social and Cultural Reconstruction

The Acholi are a predominantly agro-pastoral people whose livelihoods and culture rely on their access to land and ability to engage in farming (Finnstrom, 2008). Their forced displacement into IDP camps therefore greatly impeded their ability to provide for themselves and contributed to the disintegration of cultural norms and social structures. This study’s findings indicate that by enabling the resumption of agricultural activities, dairy projects like GWDFAs aid both the economic and social reconstruction processes in this post-conflict community.

Living in the IDP camps during the war prevented people from accessing their land and engaging in income-generating activities. For the families who joined GWDFAs, receiving a heifer enabled them to earn income for their families and return to a state of self-reliance. A recent grant from Northern Uganda Social Action Fund (NUSAf) provided GWDFAs with a 300 liter cooler, drastically improving milk sales. Instead of selling milk individually, farmers now bring milk to the cooler in the morning and the milk is sold from the GWDFAs office’s central location. On average, each farmer brings in 10-15 liters of milk per day. GWDFAs charges 1,200UGX (0.50USD) per liter, of which the farmers receive 1,000UGX (0.42USD) per liter at the end of the month. The extra 200UGX is used to maintain the office, employ workers and cover any miscellaneous operating costs. Using the cooler at the central location also allows the group to control milk quality through the use of a lactometer. As a result, GWDFAs has become increasingly popular and is able to sell milk in bulk to schools, hotels and local organizations, such as The AIDs Support Organization (TASO), at the increased price of 1,600UGX (fee added for delivery).
In keeping with the findings of other contemporary studies, research showed that the effects of the war and the IDP camps penetrated beyond the economy to shake the cultural and social foundations of the Acholi people (Finnstrom, Dolan, Weeks). The death of many elders prevented the transmission of cultural knowledge to younger generations leading to the dissolution of these non-material assets previously essential to the spiritual, social and economic prosperity of the Acholi people (c.f. Finnstrom, 2008). In the camps, the Acholi were “reduced to dependency, idleness, and debilitating uncertainty with respect to what the future may hold for them and their children” (Weeks, 2002). According to the interviewees, this diminishing cultural knowledge has led to widespread violence, selfishness, alcoholism, sexual promiscuity and general moral degradation, particularly among the youth. Therefore, camp life and the experience of war not only served to impoverish an entire people, it led to engagement in formerly taboo practices and a loss of social predictability (for a similar analysis, see Dolan, 2009).

Findings from this study suggest that membership in GWDFA and acquisition of a heifer enable families to mitigate these effects of war first by encouraging families to return to their farmlands, and second by fostering the reconstruction of communal ties and economic self-reliance. According to Ewatu Vincent, head of HI in Gulu, the pre-requirements necessary to receive a heifer include constructing a shed and planting animal feed—demands that imbue the return home with a sense of purpose and help to diminish the temptation to remain in camps and rely on humanitarian “hand-outs.” In the interviews, members could not overemphasize the importance of the return to their ancestral lands. One woman in particular, Josephine Aol, a member of HI’s project Can Opwonya, stressed that rural areas are now considered safer and more comfortable due to population decongestion and a lack of conflict and disease. Back at their homesteads, the Acholi can reclaim a sense of control over their lives after decades of forced displacement and dependency.

Furthermore, interviewees stressed the importance of membership in and allegiance to the group as a way to renew the moral and social values that form the base of Acholi culture. Dairy co-op members are inter-dependent—the individual households’ interests are tied to the group’s interests. Tuesday meetings provide a space for members to address practical concerns and offer emotional and spiritual support in the wake of the war’s trauma. Internal accountability is important to GWDFA, both to maintain the quality of their milk and to preserve social cohesion. In order to ensure that members comply with GWDFA and HI’s standards and expectations, HI extension staff conduct random, monthly, unannounced visits to the families’ farms to monitor the cow’s health and the condition of the shed, to encourage record keeping and to address any individual concerns. The threat of having a cow removed is often enough to ensure that members contribute and participate equitably. Therefore this study suggests that GWDFA members’ commitment to the collective good, as well as the emotional support they find in one another, significantly contributes to the healing process and the reconstruction of this post-conflict community.

**Gender-Neutral Project Models**

During data collection, the team focused on gender relations, specifically gender divisions of labor and women’s and men’s roles in society. Interviews from both men and women revealed sev-
eral consistent themes. First, GW DFA farmers viewed the cow as belonging to the entire family. Because Acholi men traditionally control property rights, the fact that GW DFA members register most cows in the wife’s name is unusual (Tripp, 2002). However, despite official registration, women resoundingly stressed that the whole family owned and was responsible for the cow.

This sense of so-called “hand-in-hand” communal ownership supports GW DFA's emphasis on equal distribution of responsibilities and labor within the group and individual families. Some men were initially hesitant to join GW DFA because the cow augmented their wives’ influence while increasing men’s workload. However, once the cow began producing milk and income, female interviewees said their husbands appreciated the cow and helped equally with its care. Observations of 16 farms also revealed that all members of the family contributed to keeping the cow. While women were responsible for milking, men would bring the milk into town and all family members, including children, helped rotate feeding and watering duties. One representative from each family, either husband or wife, is expected to attend every training session and convey the lessons learned to the rest of the family. Instruction topics include financial literacy, sustainable agriculture, family planning and gender equality. On average, there were three times as many women as men at the training meetings—a disparity attributed to men’s employment in town.

Interviews revealed another important and surprising trend: income from the cow is shared between husband and wife. Acholi men historically control family income, but GW DFA members overwhelmingly indicated that their income generated through animal husbandry was shared and jointly distributed. Husbands and wives often sat together to make budgets and decide how money should be spent. Lucy and James Oloya are two members who particularly emphasized that the spending and allocation of their earnings is a mutual, joint effort. According to James, having more income alleviated tension and conflicts at the home, which for him is the most important benefit of membership in the group.

The above findings suggest that GW DFA’s success may have broader implications for the efficacy of gender-neutral development projects. Many recent development models privilege women due to statistical evidence that suggests women’s tendency to reinvest in domestic capital (Blumberg, 2009). This study cautions, however, that development projects in Gulu focusing exclusively on women may be myopic; their narrow, female-centric concept of gender ignores the reciprocal relationship that characterizes men and women’s interactions within the family and society in general. By ignoring male roles, a gender-centered project has the potential to further destabilize the social fabric of a fragile post-conflict society and cause unintended harm to women (Nabudere, 2009). For example, interviewees implied that the demasculinization which results from female-focused initiatives can exacerbate rampant alcoholism and perpetuate domestic abuse. Such changes in male behavior can heighten the hardships women face domestically and socially when rebuilding a post-conflict community (Dolan, 2009).

Since this study concerns a post-conflict community, it is the team’s belief that development projects that ignore the importance of a male role may have these negative social effects, regardless of location. By privileging female leadership and allowing only for female participation, such development projects make the normative assertion that male leadership and participation will inevitably lead to gender inequality, female oppression, the impoverishment of families and/
or the overall retardation of the social and economic development of a community. In contrast, research demonstrates that the exclusion of men in the name of “female empowerment” exacerbates precisely the problems it intends to solve.

Community Benefit

In an effort to avoid extractive research and establish reciprocity, the team engaged in dialogue with GW DFA at the onset of the study to determine ways in which its various skills and resources might benefit the group. The ideas that resulted from this collaboration led to the creation of a website for GW DFA, the repainting of the GW DFA office interior and the writing of grants to help GW DFA receive a generator, cream separator and pasteurizer for future yogurt production. The team was also able to donate two bikes to the group and provide them with the means of acquiring a crucial land-line phone for their office. Funding to support GW DFA is still actively being sought out and two of the researchers’ former high schools have committed to fundraising for the group. Finally, the team has remained in regular contact with GW DFA to help them establish desired partnerships with other organizations.

Limitations

The six-week length of the trip limited the number of activities the team could organize. Due to distance between houses and the length of interviews, some of the fifty-three farmers could not be reached for personal interviews, but all were present at the trainings and focus groups. The team felt that the farmers interviewed did constitute a representative sample. However, because men were often in town, there were more female interviews, which may have skewed findings toward the female perspective. Furthermore, when Acholi translators were used, the length of the interviewee’s answers sometimes necessitated paraphrasing; which may have over-simplified the nuance of their responses. Members of GW DFA’s staff usually facilitated every conversation. These members were critical for introductions to families and direction in finding the farms, but their presence may have reduced farmers’ willingness to share critical views about the group; no farmer, however, expressed any concerns when asked if he or she felt uncomfortable giving honest responses in front of GW DFA staff.

The limited time frame and scope of the research precluded the possibility of completing a comparative analysis of similar projects in the area. However, the team was able to casually observe several other dairy co-ops whose operations seemed to indicate that such a comparison might be useful. In particular, a day visit to a smaller, more rural project called Can Opwonya seemed to indicate that factors such as access to a thriving market and electricity for a cooler were essential to GW DFA’s success and growth, in addition to their strong leadership and group cooperation. More research is needed to determine the importance of these factors, but this preliminary comparison with Can Opwonya’s project shows that a full evaluation of the HI model would require inclusion of such economic, social and environmental factors.
Conclusion

The theory presented by this research would benefit greatly from a second visit that would extend beyond a six-week period and allow a more detailed comparison of various projects in the area. Comparing projects run exclusively by women that target only women, to those run by men that target only men, to other gender-neutral and egalitarian projects would provide more informed conclusions. Researchers would thus be able to enrich their perspective on the relationship between gender roles and the development of post-conflict areas. More time in the region would also deepen the researchers’ social and linguistic fluency and result in a higher quality study.

Despite limited time, these experiences revealed the value of a renewed dialogue promoting a sense of partnership and cooperation between men and women. In this study, the HI staff maintained that GWDDFA was one of the most successful of their 13 projects in Gulu. The group members and the staff of GWDDFA and HI indicate that this success is based on their “hand-in-hand” approach to the reconstruction of their families and communities. By incorporating couples into the training, care and ownership of the cow, men and women are able to mutually benefit from the project. This study suggests that development projects that focus on gender balance rather than gender exclusivity better maintain the reciprocal relationship between men and women, especially in post-conflict societies.

References


**Biographies**

**Anna Conn** is a fourth year Global Development Studies and French major. Her concentration is in Western Africa and she is specifically interested in the relationship between human rights and conflict resolution. She hopes to gain experience in the peace and reconciliation sector next year.

**Kappie Farrington** graduated in 2010 with a degree in French and Art History, with an emphasis on francophone Africa and international development. She now works at M-CAM, developing projects that enable global, equitable access to innovation, information and value exchange.

**Rachel Leeds** is a fourth year student studying Anthropology and Global Development Studies. She is writing her thesis on gendered aspects of the urban-rural divide in Kenya and hopes to serve in the Peace Corps in West Africa after graduation.

**Sarah Munford** is a fourth year Global Development Studies and Foreign Affairs major. She has focused her studies mostly on Southern and East Africa, but plans on entering the domestic non-profit sector next year.
Home Energy Education in Charlottesville, Virginia

By Elizabeth Engel, Ethan Heil, Matt Jungclaus, and Quinn Weber

Abstract

A team of engineers from the University of Virginia analyzed home energy usage and worked with the Local Energy Alliance Program to develop educational displays for an energy efficiency showcase in Charlottesville, Virginia.

Introduction

Shelter and Energy are two topics that dominate much of our lives. Every day we interact with and utilize these two resources almost constantly. When combined, they create the place that we eat, sleep, bathe, entertain and relax: our home. While we do not typically think of our homes as large energy sinks, the residential sector accounts for over 30% of all non-transportation energy in the United States (U.S. Energy Information Administration, 2010a). Of that, 40% is used purely to heat and cool the homes (U.S. Energy Information Administration, 2010b). In light of current concerns regarding dependence on foreign oil and the social and environmental ramifications of coal (our two largest sources of energy), the implications of our home energy use seem to be increasingly more important (U.S. Energy Information Administration, 2010c). Additionally, our aging, less efficient housing stock and increasing energy demand make it apparent that home energy efficiency is a topic not to be taken lightly (The Old House Web). Knowledge of this problem creates a sense of obligation to take action to correct it.

The ecoMOD program, a joint effort by UVA, the City of Charlottesville and the Local Energy Alliance Program (LEAP) recognized the need to take action. LEAP, a local nonprofit formed in 2009, combats home energy inefficiency most directly. The mission of LEAP, as defined on their website, is “to lead the effort in our local community to conserve water and energy in buildings to promote cost savings, job creation, sustainability, local economic development, and environmental stewardship” (The Local Energy Alliance Program, 2010). To lead this effort successfully, LEAP has recognized the need to educate the community about energy efficiency. Before any societal changes are made, individual people must learn about and understand the relationship between themselves, their homes and the environment. The community as a whole must recognize the need to take action and it is through education that LEAP will empower them to do this.
This education will begin with the ecoREMOD project. This project is a complete energy efficient remodeling of a local home that, when complete, will serve as both the headquarters for LEAP and a showcase for energy efficiency in Charlottesville. This Jefferson Public Citizens team was formed to develop the educational materials to be displayed in the home.

**Approach**

The team began by establishing an understanding of the “current state” and formulating the desired “future state” of education about energy efficiency in Charlottesville. The current state is limited. Even if people understand the problem, they have limited means of learning how they can take action to fix it. This must not be true for the future state.

The ecoREMOD home will contain posters, videos, computerized displays, models and literature. These resources will educate the community about the current problem, convince them of the need to make changes and provide information for how the problems can be solved. The information will be presented in a way that is informative, persuasive and understandable. The exhibits will highlight common areas of inefficiency in buildings and suggest a range of home energy solutions and upgrades. Starting with basic topics such as air sealing and insulation, the exhibits will aim to present a simple, logical flow of information. If visitors are interested in obtaining more information about a specific topic, resources will be provided on both the LEAP website and in the form of literature available at ecoREMOD. One important element of the showcase will be displays that highlight specific renovations and upgrades performed on the ecoREMOD house. Included in this will be a “window” into the actual insulation and construction of a wall, a graphic display of real-time solar panel production and a comparison of heating and cooling systems. In order to give the exhibition more of a storyline, the students and LEAP will show interviews of homeowners speaking about their experiences with home energy renovation. The development of this showcase is an ongoing process, and will evolve as ecoREMOD becomes operational.

In order for this desired future state to be achieved, there must be a large supply of data supporting the displays to provide the community with convincing evidence of previous success. The issue encountered here is the general lack of information regarding the success of different renovation technologies. In order for an analysis of a renovation to be done correctly, at least one year’s worth of data on the performance of the technology must be gathered. Essentially, with one year’s worth of post-renovation data, one can tell what effect the change had on heating, cooling or general energy use (referred to as baseload energy use). A homeowner cannot be certain that their investment was worthwhile until a full year after the technology has been installed. With this full year of data, extraneous data points and abnormal weather conditions can be accounted for without skewing the data set completely. To find the necessary quantity and quality of data to use as a basis for the educational materials, the team began by collecting data from renovations that took place in 2009 as part of Charlottesville’s SPARK! program. The quantitative data collected from these homes included monthly electricity, natural gas and water bills. The qualitative data included observations and interviews of the homeowners.
In addition to collecting data, the team recognized the potential benefits of interaction with the different stakeholders in LEAP, which include LEAP employees, contractors and homeowners. Gaining an understanding of their role in LEAP’s process would be crucial to developing educational materials that accurately represent the information. To do this, several team members spent a summer working directly with LEAP as building science interns. They assisted in performing energy audits, trained as certified Building Analysts and spent time with individual homeowners. This experience gave the team a solid foundation of knowledge and understanding about the industry which aided in the development of informative and relevant educational materials.

With this background of data and experience in the industry, the team began the development of the materials. The team’s two primary contributions to the ecoREMOD home are Home Energy Profiles and educational videos.

**Results**

Analysis of the data collected showed mixed results. Some homes that received similar upgrades experienced differing levels of success. For example, in one home $7,000 dollars was spent to significantly improve the insulation as well as the moisture and air barriers. Their annual energy consumption decreased by 36 percent. A graph showing this improvement can be found in Figure 1. Another home that underwent similar renovations saw a net increase in energy consumption which is shown in Figure 2. Understanding the root cause behind this discrepancy would be crucial towards developing effective educational materials. Further study of the home showed that while the physical changes made to the home were similar, the behavior of the homeowners was different. Homeowner interviews indicated that the owner with higher energy use tended to set their thermostat to higher temperatures during winter months and to lower temperatures during the summer months. This study indicated that there are several factors that influence total home energy efficiency, and the educational materials would need to communicate this.

The data and information from each home was organized into Home Energy Profiles that would be available to the community. The one page template consists of various sections that explain different aspects of the home energy renovation process. The first section details the background and general information of the home such as square footage, number of bedrooms and bathrooms, year of construction and a picture of the home. This allows the reader to form a mental image of the home and

![Graph](Figure 1) Improvement in home energy usage is shown for a renovated home.
put it into context. The next section explains what specific renovations were completed. The reader will see this and understand what specific action can be taken to improve their home. In addition to a description of physical changes, the section describing behavioral changes addresses the relationship between the homeowners and the home. It is important to communicate that energy can be saved not just with expensive renovations but rather through simple behavioral changes. The final section gives a summary of the energy bill data and several useful statistics about the renovation. These statistics are energy per square foot and simple payback. The latter is calculated by dividing the total cost of the renovation by the annual savings. For example, one home had a simple payback of 6.3 years, meaning that the money saved over a 6.3 year period would equal the amount of money initially invested. After that point, the homeowner has paid back the investment and will only save money as a result of their investment.

The profile contains a section explaining the importance of knowing a home’s annual energy usage per square foot. Homes with high energy use per square foot will generally have more obvious causes of energy loss than those with lower values. Therefore, as this number is lowered as a result of renovations and upgrades, the marginal cost of making improvements greatly increases. For example, a house with high energy use per square foot likely suffers from serious energy loss and air flow issues that would be greatly improved with basic insulation and air sealing measures. A home with a lower energy usage might require more advanced materials, a greater quantity of insulation, or advanced energy saving measures that have a longer payback period. Knowledge of this statistic is an important first step in understanding what should be done to a home.

The second contribution of this team to the ecoREMOD showcase was the development of educational videos to be displayed both in the home and on LEAP’s website. Footage of contractors working on homes was combined with interviews explaining different technologies to make these videos. They will serve the dual purpose of educating the community and creating positive publicity for LEAP. One video explains the application and use of high density sprayed polyurethane foam insulation and its advantages in simultaneously creating thermal, vapor and air barriers. The contractor then demonstrates the process of spraying this foam. Having the ability to view videos such as this, both in the ecoREMOD home and online will educate the community about the different options that exist for renovating their home and hopefully convince them to upgrade their homes.
Discussion

The progression of this project occurred in a manner that was not anticipated by the students. The nature of construction and remodeling projects is such that delays and changes in design are by no means uncommon events, especially with the additional constraint of historical preservation. The delays in this project were likely further compounded by the number of stakeholders involved in the project including, but not limited to: a University, its students and professors, a city municipality, a non-profit organization, several subcontractors and the Board of Architectural Review. One major cause of delay in the project was the approval of design and renovation plans. Due to the historical nature of the ecoREMOD house, certain stakeholders had a vested interest in preserving elements of the home which were not identified at the beginning of the design process. This resulted in longer than expected design time and hindered the timely completion of the renovation and the associated educational materials. Throughout the course of this project, the students often encountered issues wherein schedules and designs were constantly changing. Instead of remaining static in their original plan, though, they continued to adapt as new issues arose and new solutions were developed.

The team has been working with the final layout of ecoREMOD and display plans in order to develop a cohesive design for the exhibit. The Jefferson Public Citizens team has been in ongoing contact with LEAP about the exhibit so that mutual expectations are upheld, and so that there will not be a delay in opening the showcase to the public once ecoREMOD is completed in the coming months. The content and layout of the displays depend on the community partner's vision; the team does not wish to rush the finalization of any plans without completing the process hand in hand with the community partner.

While originally daunting, the controlled chaos (as it appeared to the students at first) of this project grew into an unanticipated learning experience. It is safe to say that the members of this student team are now much more familiar with the processes involved in large, multi-stakeholder projects, especially those relating to construction. They have also developed the skills to be able to continually adapt their designs to appease many stakeholders while maintaining the importance of clear and consistent communication.

The relationships developed during this JPC project extend beyond the scope of the originally described proposal and work plan. As such, though the official JPC project timeline is complete, the students and greater project will continue. The students continue to interact with LEAP and work towards fulfilling the vision of ecoREMOD as a showcase for energy efficiency in the Charlottesville Community.
References


Abstract
The ongoing Water and Health in Limpopo (WHIL) Project, in partnership with the University of Venda, is working to assess and implement a means to enhance the quantity and quality of water for the rural South African communities of Tshapasha and Tshibvumo. The 2010 WHIL team employed a Slow-Sand Filter and a Community Engagement component, with the objectives of installing improved water-filtration technology and educating the community about sanitation in order to augment community involvement in this infrastructure. During the eight weeks spent in the villages, the team encountered considerable impediments to the construction of the filter due to political discord. However, the project’s initiatives in the form of a Clean Water Camp in primary schools, a message board and a public Water Fair demonstrated the value of community engagement in bypassing political issues, encouraging autonomous initiative in students and ultimately fostering a healthier partnership between the WHIL team and the community members.

Introduction
The Water and Health in Limpopo (WHIL) project began in May 2008, collaborating with the University of Venda (UNIVEN) to address the Limpopo community leaders’ number one concern - poor access to clean, potable water (Annegarn, H.J., Swap, R.J., Walther, S.C., n.d.). Statistics from 2002, when the idea for the WHIL project was first conceived, showed that the Limpopo Province is one of South Africa’s poorest regions. Over 60% of the population lives below the poverty line and many are heavily burdened by disease. Nearly 20% of the population is infected with HIV and water-borne diseases are rampant (Annegarn et al., n.d.). Diarrheal disease in Limpopo is second only to HIV as a cause of death, partially due to the 90% of the province’s population that lives in rural areas with limited access to potable water and sanitation (Annegarn et al., n.d.).

In order to provide the South African communities of Tshapasha and Tshibvumo with sufficient access to clean water, a group of four fourth year engineering students expanded upon the 40,000 liter water filtration system implemented in 2007 by UVA’s Engineering Students Without Borders and their South African partners (Harshfield, Jemec, Makhado, Ramarumo, 2009). The improved slow-sand filter, built in the summer of 2010, was projected to both improve the quality of the drinking water and increase the quantity from about 87,500 to the 175,000 liters per day required to meet basic human needs (Gleick, 1996).
In past years, the WHIL project realized a disconnect between community members and WHIL project leaders, as the people in Tshapasha and Tshibvumo did not have a clear understanding of the project goals and methodology. For this reason, the community engagement part of the project discussed in this paper was founded and implemented during the summer of 2010.

The goal of the project was to educate the villages about health and sanitation issues and create a sense of urgency regarding diarrheal disease. Ultimately, the team wanted to foster dialogue between the WHIL project and the community, prompting discussion about the topic as well as promoting acceptance of and participation in the WHIL project’s endeavors.

This paper will concentrate on the community engagement component of the WHIL project. Described above are the initial project goals prior to interacting with the communities. However because of the collaborative nature of the project, both with the students at UNIVEN and the community members, the objectives and methodology were constantly adapted based on feedback and perceived attitudes.

**Methodology**

With the goal of community engagement in mind, the team settled on several strategies to approach this challenge from different angles. First, the team hoped to reach out to the schools in the two villages—namely Tshapasha Primary School in Tshapasha and Mboneni Primary School in Tshibvumo. Through previous connections made by past WHIL students, meetings were set up with teachers and principals from both schools. At these meetings, a proposal was discussed alongside several revisions and reservations felt by the community partners. Taking this feedback into account, the community engagement strategy was divided into three main parts: the Clean Water Camp (CWC), Clean Water Fair and message boards. To obtain feedback about all of these initiatives and understand the communities perception of WHIL, two focus group tests were conducted—one in each village—comprised of adult family members of students in the Clean Water Camp.

**Clean Water Camp (CWC)**

The keystone of the team’s strategy was the plan to work with local youth to spread the word about the importance of clean water practices. It was hoped that working with the youth would foster an environment that allows for open communication and encourages participation. Participation is part of a critical thinking, problem solving and experiential approach to learning. Through youth-initiated action, young people learn how to collaborate with one another and develop problem-solving skills. They gain their own understanding of citizenship and develop roles for themselves as part of a democratic society, which subsequently promotes a conscious sense of responsibility and stewardship to the community (Friedmann, 1998, p. 9-17).

Before arriving in South Africa, the anticipation was to be able to work with these students during the course of a typical school day. However, because of the World Cup, school was not in session during the designated times for the project. At the initial meeting with school officials the team reformatted its plans to offer a Clean Water Camp. Although this camp would not be
able to reach every student in the two schools, the team was able to work with a core group of twenty from each school, all selected by their teachers. This group included students age 6 to 13 years who were leaders in the classroom, because we believed that student leaders were also most likely to take what they learned from the camp and effectively disseminate it amongst their peers.

After two groups of twenty students were selected by their teachers, the UVA-UNIVEN teams scheduled five two-hour camp sessions for each group. These sessions were conducted over a period of two weeks. For each session, a lesson plan was created which included a variety of activities and a snack time. The purpose of the snack time was to allow students a break, but more importantly to allow them to wash their hands, cementing an important practice stressed in the sessions. The activities varied in nature from group work to individual work.

**Water Fair**

The Water Fair was an event held at the culmination of the Clean Water Camp. The goal of the event was to present the work of the students from the last two weeks to an audience including village chiefs and officials, school faculty and administrators, parents and community members (Cunningham, 2008). At the Fair, groups of students presented skits they had prepared featuring lessons learned during the Camp, as well as orations that they memorized. In one skit, students acted out a scene in which a teacher was explaining to her students the dangers of unclean water collection. Students discussed some solutions to the obstacles of clean water collection in an oration. Some of the content was in English and some in their local language, depending on the language ability of the individual students.

After the performance portion of the Fair, a meal was served to all in attendance. The goal was to create a sense of celebration that would reflect the accomplishments and hard work of the students and breed goodwill for the WHIL project. A microscope was set up so that community members could see for themselves some evidence of the dangers the students discussed in their performances. At the end of the student presentations, members of the WHIL team fielded questions from the audience about the project. Many people had questions about the operation of the slow-sand filter, and this gave the team a chance to explain common misconceptions. Feedback was also heard—both positive and negative—from members of the audience.

**Message Boards**

The idea for the message board originally came from the water project conducted by UVA students in La Gracia, Belize. They constructed two message boards at two village stores that were to be responsible for maintaining the water system. Their board functioned as a way to “create transparency and regular communication with [residents]” (Evans et al., 2010, p. 19). Additionally, “[The message boards were used to] inform [community partners] of daily activities and provide a means for anonymous feedback” (Evans et al., 2010, p. 19).

The Limpopo message boards were similarly built next to the two local schools as a way to
protect them from vandalism and ensure that a responsible body of individuals would oversee their use. However, unlike the La Gracia project, the message boards were not to be used by WHIL project members, but rather intended for each village’s water committees as a means to relay facts and information both about the WHIL project and about general health/water related issues in the community. The boards were also constructed to allow community members to post anonymous feedback to the water committees, suggesting improvements to the system and highlighting their personal issues in a non-politicized manner. The team worked with Water Committee volunteers to construct the boards, successfully installing one in the schoolyard of the Primary School before our departure. The second board was planned for the second village, but there was debate about its best location. When field work concluded, the board was complete but had not yet been installed in the community.

Results

Political Obstacles with the Slow-Sand Filter

The construction of the slow-sand filter deviated greatly from its planned timeline due to an onset of unforeseen political obstacles. The stand-in chief in one of the villages, who traditionally supported WHIL’s efforts, was replaced by his brother, the true chief, who had not lived in the village for an extended period of time. Because of this, the villagers accepted the stand-in chief as their leader rather than his brother because he was his father’s choice. Thus, WHIL members were caught in the middle of a political debate and were unsure how to best interact with the leaders without offending them. To complicate matters further, the filter that was to be revised had been built during the previous summer in the stand-in chief’s yard (as a way to protect it from vandals and ensure responsible ownership). This upset the true chief, spurring tension between WHIL and the village. Furthermore, the water committee in this village refused to meet with the rightful chief, making progress towards constructing the filter even more difficult.

Unfortunately, these complications slowed the start of the slow-sand filter by three weeks, but rendered community engagement all the more vital. The support of those in the community swayed the chief to allow the construction of the slow-sand filter to proceed.

Clean Water Camp (CWC)

Initially, the goal of the Clean Water Camp was to educate the student leaders in the two villages about health and sanitation issues to prompt participation in the WHIL project. Through activities like the “Clear Water is not Always Clean Water” game, the learners demonstrated their growing knowledge of sanitation and healthy water habits (Firehock, 1995, 52-53). During focus groups conducted with the children’s parents, participants responded that the lessons were influencing students’ and family’s hygiene practices in positive ways.

Certain aspects of the CWC curriculum were adjusted to better accommodate the knowledge base students already possessed. For example, the curriculum originally contained a lesson explaining germ theory at length through a microscope demonstration with local stream water.
This lesson, however, was condensed as many students in the class were already knowledgeable on the subject due to the 2009 Zimbabwean cholera outbreak. The children had read newspaper articles related to the outbreak and had viewed pictures of the bacteria printed in the same source. This understanding was demonstrated when students were able to draw accurate pictures of a cholera-like germ during an in-class activity.

In place of the initial germ lesson, a class about water conservation was taught by the UNIVEN partners per request by both community members and other UNIVEN students. This lesson covered an important water-related topic the team had been unaware of prior to the CWC class.

During the focus group tests held to assess the results of the program, one mother explained how her daughter had “begun taking a bucket of water with her when she used the bathroom so she could wash her hands afterward…. [which] she never did before the camp” (Focus group, personal communication, June 17, 2010). Other parents responded similarly saying the camp was “relevant because kids will give encouragement to elders” (Focus group, personal communication, June 17, 2010) or that they were “impressed about teaching washing hands [because] most children don’t wash hands very often. Children can now remind their friends” (Focus group, personal communication, June 17, 2010). The adults’ stories about their children’s changed hygiene practices clarified that educating children is an effective way of spreading information amongst parents and elders.

Additionally, the adults were able to provide critical feedback on the program, suggesting the inclusion of lessons on traffic safety and the extension of the program to adults – ideas that are feasible and legitimate. Based on this feedback, the CWC’s original goals were recalibrated to focus on expanding the curriculum and reaching a greater majority of the children and adults throughout the community. Rather than focusing solely on water and hygiene, it would be beneficial to encourage the individuals to self-assess their needs and thereby help to redefine CWC’s future contributions and the larger WHIL project’s work. One of the student’s brothers commented that he “believed that this camp will help the kids in their career choices in the future and open up many opportunities” (Focus group, personal communication, June 17, 2010). The Clean Water Camp, by addressing the problem of water health, was not only able to target a crucial community need, but also developed leadership and problem-solving skills among the students.

Water Fair

The water fair served as a unifying public event, bringing together parents, elders, teachers, children, water committee members and chiefs as the students presented what they had learned during the CWC. Despite the political issues in one of the villages, the schools provided a welcoming opportunity to connect with the community in a neutral manner. Likewise, the water fair united both political and nonpolitical entities, providing an opportunity to interact with and teach the community as a whole.

The chiefs and water committee members were able to hear what had been taught during the
course of the CWC in a forum virtually free of political debate and rivalries. This created a common ground of understanding between WHIL and both traditional and non-traditional leaders. The fair eased tensions between the UVA/UNIVEN representatives and village leaders as the separate forces were reunited in the common goal of providing clean water to the community and the children.

**Message Board**

The intended use of the message board proved to be a weaker aspect of the engagement project due to its unsustainable nature. The flawed design of this portion of the project resides in the fact that the water committees are a group of individuals brought together by WHIL's foreign concept of a public interest group. The water committees run the risk of becoming politicized or sedentary, which threatens the success of the “sustainable” water filter system. The problems the water committees face are similar to the potential issues with the water filter itself – the systems run the risk of either becoming the source of political tension or suffering from a lack of accountability.

Although it is unclear whether the message boards will be used directly as part of the WHIL project, as was intended, building the boards proved to be an important bonding activity for the community, schools and water committee members. All those involved voiced their excitement in having been part of the construction of a physical sign of accomplishment. This enthusiasm seemed to stem from communal impatience for tangible results to materialize as a result of the project.

In an effort to ensure that the message board remains active and is constructively used, both the water committees and schools were given permission to utilize the message boards for discussions about the WHIL project and water issues in the community. Hopefully the water committees will utilize this tool as a means of interaction with the community. But if not, the schools can take advantage of the space and use it to display student artwork and projects created as a part of the clean water curriculum to be implemented.

**Discussion**

**Bypassing Politics by Becoming Equals**

Working in the two villages throughout this project proved to be an educational, effective and politically neutral means of forming strong ties to the community, thus making projects more likely to succeed. This is especially true if researchers enter the classroom as knowledgeable equals rather than condescending instructors. By expelling an authoritarian role from the instructors in this camp setting and adopting a co-learning perspective, one can more easily develop a trusting, personal relationship. Aiding the local people as a donor or philanthropist is neither sustainable nor powerful. A strong synergy between researchers and the community brings about natural incentives, in the form of genuine interest and mutually beneficial results. Both of these goals have presented a challenge for WHIL teams, and development projects in general, to achieve as a result of using extractive research methods.
“Making” Sustainability

By forming projects around the goal of enhancing initiative within the community, ideas become inherently more sustainable as the native people are put in control of their situation. The education program implemented this past summer is not an intrinsically sustainable concept, as it was not based on the area’s natural assets. However, the program is based on the foundations of reciprocal learning and personal development. Even if it only perseveres for a finite number of years, the program has the potential to educate and empower future leaders. Training young minds to question the status quo and take action has infinitely more sustainable power than could ever be unleashed by a group of temporary researchers. According to youth participation researchers Gurstein, Lovato and Ross, “They [youth] have a great deal to teach youth and adults alike about participation, which whole communities will recognize when they begin to perceive their younger citizens as assets and resources—agents of change who bear valuable tools that can illuminate new paths of community development” (Guerstein, Lovato, and Ross, 2003, 249-274).

Projects Based on Community Assets

One of the fundamental challenges WHIL faces is the nature of the project – the slow-sand water filter is being constructed as a solution to a problem not originally conceived by the villages. True, the villagers wanted a larger quantity of water, but they were not concerned with the quality nearly as much if at all. For many individuals, the filter is not as important as the JoJo tank used to collect the water. For this reason, the community engagement component of the project, which highlighted the need for potable water, was crucial to the project’s sustainability. However, a flaw in this project’s design was the separation of the construction from the engagement. Though the children and community members were motivated to improve the villages’ water quality and sanitation as a result of the engagement endeavors, they were still disconnected from WHIL’s objectives because of their limited ability to actually participate in the core of the project – designing and implementing the filter.

This complex problem, however, could not be resolved simply by letting all those in Tshapasha and Tshibvumo build the filter. Because of the technical nature of the skills required for proper implementation of the filter, it is a challenge even for professionals in this field. This makes the project more difficult than most, as people may be inspired to take steps to improve their situation, but then are immediately exposed to a project that is both complex and foreign.

Understanding the complications of the WHIL project reveals that the most naturally successful projects are those that build upon existing communal assets, whether in the form of knowledge, skills or technology. These organic solutions are more natural, sustainable and empowering as they do not rely on the mindset of other cultures or the skills of those who will only be present in the community for a finite period of time.
Limitations of the Project

WHIL, like many projects requiring a large dedication of time and funds, is limited by its long investment in the current water filter project. Scientific research is not a linear process (from question directly to answer) - it takes multiple attempts, feedback and reflection to understand how to move forward. A true research process requires continuous revamping and redirection with each installment of information because there is no true way to predict what will be encountered. The “six-phase” sand filter implementation plan that WHIL has been dedicated to for the past three years has provided an organization strategy for a complex project. However, it limits the workers’ abilities to be responsive to community feedback because of the solidified structure.

Many of the limitations that the construction component of the WHIL project faced could be addressed by better integrating the community engagement efforts with the project as a whole. However, education’s effectiveness is also limited when used as a singular tool to facilitate development. Education is a crucial element in community engagement projects as a means to keep residents invested in the outcome. It is impossible to implement successful changes using only education when a host of other resource needs exist. For example, it is difficult to teach children to take initiative and improve the quality of their water when they neither have the resources to educate themselves on the subject nor the funds to invest in their ideas.

Benefits to the Community

Despite these limitations, the WHIL project has demonstrated an ability to reflect on its past actions and take steps to revise those weak points. The slow-sand filter has a strong foundation and significant support from both UVA and UNIVEN students and faculty. Better integration with the community will lead to an improved livelihood for those in Tshapasha and Tshibvumo. The implementation of the filter will be most effective when engineering engagement successfully works towards catalyzing existing knowledge into creative solutions by supplementing it with an engineering expertise.

Furthermore, the educational program developed during the past summer has shown promise in mitigating political obstacles with the slow-sand filter. A healthier partnership with the community and local governments is emerging and will hopefully continue to grow as the educational component of the project becomes more focused on leadership development and community autonomy. By expanding upon the strong ties created in the school system, university and villages, the WHIL can foster a mutually beneficial venture.

Biographies

Erin Boehmer is a second year Systems Engineering and Computer Science student interested in the use of software in development work.

Rachel Smith is a second year Biomedical Engineering student involved in Engineering Students Without Borders.

Melina Schoppa is a second year Foreign Affairs major hoping to pursue graduate study in Public Policy. She is returning to South Africa this March to continue work on the water health curriculum.
References


Abstract
As urban development continues to spur the transformation of pervious natural surfaces into impervious roadways, buildings and parking lots, the sustainable management of stormwater runoff is becoming a critical issue if we hope to protect our local waterways and aquatic life. The City of Charlottesville, Virginia recently constructed a vegetated bioswale to management the stormwater runoff at Charlottesville High School. Bioswales, also known as a rain gardens, are designed to capture and hold stormwater runoff rather than allowing it to flow into underground pipes. In so doing, the system reduces peak discharge, filters the runoff and recharges the groundwater table. A team of undergraduates, faculty and staff at the University of Virginia, in collaboration members of the Rivanna River Basin Commission, sought to analyze and quantify the performance of the biofilter. Utilizing auto-samplers, flow meters and a range of lab equipment, the team concluded that the system was functioning as designed. Both nutrient load and peak discharge are being successfully attenuated as the runoff passes through the system.

Introduction
Stormwater is traditionally defined as rapidly flowing water originating during rain events that flows along impervious surfaces and drains into natural or artificial bodies of water. Stormwater can be detrimental to the local environment in two ways: (1) the sheer magnitude of runoff greatly increases peak discharge and can lead to severe erosion downstream; and (2) physical and chemical contaminants are mobilized, affecting both water quality and aquatic life. Indeed, non-point source pollution, which is carried by stormwater runoff, is the major cause of water quality impairment in the nation. “Stormwater runoff from the built environment remains one of the great challenges of modern water pollution control, as this source of contamination is a principal contributor to water quality impairment of water bodies nationwide” (National Academy of Sciences, 2009). Furthermore, urbanization increases the volume of runoff contributing to downstream flooding and ecosystem damage (Ippolito and Podolak, 2008). In pre-developed settings, rainfall has the chance to infiltrate into the soil where it is treated by natural processes. When impervious surfaces replace these natural settings, however, runoff is forced to flow directly to surface waters without giving vegetation and soils the opportunity to slow and treat it (Virginia Department of Forestry, 2009).
Concerns about the water quality of the Chesapeake Bay have motivated many communities within that watershed to improve the local management of stormwater runoff. The City of Charlottesville is taking steps to treat its stormwater by employing a range of techniques. One of these has been the construction of bioswales, or rain gardens. These systems are situated below the surrounding surfaces and are designed to attract and hold runoff instead of forcing it into impervious storm sewers. As the stormwater collects in the basins, it is given time to infiltrate into the soil column (Dunnett and Clayden, 2007). In so doing, peak discharge is attenuated and plants and other microorganisms present in the bioswale naturally take up nutrients and other pollutants, thus filtering the runoff before it percolates into the ground (Asleson et al., 2009; Lee and Bang, 2000).

In an effort to build upon previous stormwater management research on the Grounds of the University of Virginia, a team of undergraduates, faculty and staff, in partnership with members of the Rivanna River Basin Commission (RRBC), sought to evaluate and analyze whether the newly constructed bioswale at Charlottesville High School (CHS) was functioning as designed (Downey et al., 2009; Arthur et al., 2009). Collecting and analyzing samples throughout the summer, fall and winter of 2010, the students worked to quantitatively measure the performance of the CHS biofilter in an effort to determine whether the biofilter was removing sediment and nutrients mobilized in the runoff and whether it was successfully attenuating peak discharge.

**Methods**

**Collection of Water Samples:** Two ISCO automatic event samplers were installed at the inflow and outflow pipes of the biofilter at Charlottesville High School in June of 2010, before the team started the project. Both samplers collected 300 mL of water into 24 bottles lined with individual Whirl-Pak bags over 5 minute intervals at the inflow and 10 minute intervals at the outflow. The samplers were triggered by a flow rate of 4 gallons/minute or higher during a storm event. Once triggered, the samplers collected samples continuously until all 24 bottles were filled or until there was not enough water to collect 300 mL of water.

Once sampling was complete, the bottles were collected from the base of the ISCO samplers, taken to the laboratory and stored in the refrigerator until they were analyzed for nitrate and phosphate concentrations. For longer storms, we refilled the bottles with Whirl-Pak bags every two hours in order to ensure a continuous sampling process. All samples were analyzed within 48 hours after collection.

**Analysis:** Water samples are analyzed using a CHEMetrics V-2000 photometer for nitrates and phosphates and data is interpreted using the Oakton T-100 turbidimeter. The photometer analyzed the color intensity developed in pre-loaded reagent ampoules when combined with portions of each water sample as directed by each testing kit. The turbidimeter enumerated the loss of light intensity, indicating the concentration of suspended particles and particulate matter in each sample; directions were closely adhered to as prescribed in its Basic User Manual.
Nitrate: Prior to analysis, the sample bag was shaken by hand to ensure homogeneity. For determination of the concentration of nitrate in a stormwater sample, 15 mL of sample was poured into a reaction tube. A packet of powdered cadmium provided by CHEMetrics was added and the tube capped and shaken continuously for three minutes. The tube was then left standing for two minutes to let the cadmium settle to the bottom of the tube. Next, 10 mL was carefully poured from the reaction tube into a 25 mL sample cup. After 10 mL of the solution was poured into the sample cup, a Vacu-vial ampoule was inserted into the solution and the glass tip broken off inside the sample cup. Upon breaking the tip, sample was aspirated into the reagent-loaded ampoule, leaving a bubble for mixing. After mixing by turning the vial upside-down and back a few times, the vial was inserted into the CHEMetrics V-2000 photometer. After ten minutes to allow for color development, the measured concentration of nitrate was reported on the instrument panel in units of mg/L. The concentrations were recorded by hand. We did not have enough vials to measure the nitrate concentration of every sample. Given the expense and the availability of the reagent ampoules for this project, a decision to analyze every other sample was made to allow for full coverage of the storms.

Phosphate: For phosphate determination, a 15 mL stormwater sample was poured into a sample cup to which two drops of activator solution were added. After sealing the sample cup with a black rubber cap, it was shaken to mix the solution. Then, a Vacu-vial ampoule was inserted into the sample cup and the glass tip broken off, causing the ampoule to fill. After mixing by inverting the ampoule several times, the ampoule was placed in the CHEMetrics photometer. Following a three-minute period that allowed for color development, the phosphate concentration was reported on the instrument panel and recorded by hand in parts per million.

Turbidity: To quantify the suspended sediment and organic matter in each sample, a protocol was followed to ensure accurate results. First, each bag was shaken to preserve homogeneity. Then, prior to running each set of samples, the Oakton T-100 Turbidimeter was calibrated on a flat surface using the standard Nephelometric Turbidity Unit (NTU) standards provided by the manufacturer to avoid cross-contamination of samples and standards. Immediately preceding phosphate and nitrate analyses, an aliquot of each sample was poured into a clean 15 mL glass jar to the scored line indicating a volume of 10 mL. The outside of the glass container was swabbed by a Kimtech Kimwipe to remove water spots and fingerprints. The sample jar was then inserted into the cell compartment of the turbidimeter, aligned with the orientation marks and sealed by an encapsulating black cap. The turbidity expressed in NTU was documented after the reading was stabilized for about 13 seconds.

Disposal/Containment: Upon collection, each stormwater sample was stored in a locked refrigerator with a regulated temperature of approximately 44 degrees Fahrenheit (seven degrees Celsius) in a secure lab on the University’s Grounds. Tested samples were poured into appropriate hazardous-waste labeled containers and collected by technicians of the University of Virginia Office of Environmental Health and Safety.

Flow & Load Concentration: The load of the water samples, measured as mass divided by time, was calculated by multiplying the concentration, the mass of each divided by its volume, by the discharge
time, orflow, the volumedivided by time. Sample concentrations were analyzed against blanksamples of known nitrate and phosphate concentrations for consistency and accuracy; the measurements taken from the instruments were also calibrated for quality assurance in the same manner.

Calculations: After the concentrations of nitrate and phosphate were recorded, the concentration data was synthesized with the flow data in order to calculate nitrate and phosphate loads. Since the flow was recorded in fifteen-minute intervals while the samples are taken at five- or ten-minute intervals, the time intervals for the stormwater samplers and the time intervals for the flow meter were aligned in spreadsheet calculations. In order to calculate loads, we multiplied the concentrations (mg/L) by the volume in that time interval (L).

Results

Data was collected from seven storms ranging from 0.29 to 0.45 inches of precipitation. The storms fell on July 10, July 12, July 14, August 4, August 16, August 18 and August 24.

Overall, the nutrient load was significantly reduced with pollutant removal efficiencies of 96 percent for phosphates and 69 percent for nitrates. When comparing inflow and outflow hydrology, the biofilter dramatically reduced the total volume flow, reduced the peak flows and increased the time-to-peak, which collectively demonstrates a reduced flashiness as a result of the biofilter's installation. Figure 1 is a visual representation of the nutrient loading over the course of the summer.

The removal efficiency of the biofilter was consistent throughout the summer. To provide an example, a storm on July 14 resulted in typical reduction behavior. The storm was preceded by 23 antecedent dry hours and dropped 0.32 inches of rain over the course of 2.5 hours. Due to the unusually large size of the storm, it was the only one that triggered the outflow sampler. This allowed for the first real comparison between the water quantity and quality flowing into and out of the biofilter. The significant decrease in peak flow was hypothesized from the design of the biofilter. The total volume of water coming through the inflow sampler was recorded by the flow meter as 11,456.37 gallons and the outflow passed only 1180.94 gallons. This

(Figure 1) The average nitrate and phosphate concentrations for inflow and outflow for all seven summer storms.
was a 10,275.44 gallon or 89.7% reduction in flow volume from the inflow to the outflow. The filter also delayed the flow from the inflow to the outflow. The time elapsed between flow meters for peak flow volume was 15 minutes. The sudden spike in the flow rate was significantly reduced as the outlet discharge increased much more gradually, seen in Figure 2. The sudden fluctuations in these rates are harmful to receiving waterways because rapid flow rates can erode creeks and even burst storm pipes underground.

In addition to the mitigated flow volume, the biofilter largely reduced the nutrient levels in the outflow. The two nutrients that were observed were phosphates and nitrates. The biofilter demonstrated high levels of removal efficiency in mass and event mean concentrations (EMCs). From the lab tests run on the water samples collected from the July 14th storm, the nitrate load was reduced by 10,339.5 mg, from 10,990.1 to 650.6, while the phosphate load was reduced by 5,767.9 mg, from 6,032 to 264.1. These are 94.1% and 95.6% removal efficiencies respectively.

Discussion

The team of undergraduate students set out to evaluate a recently constructed stormwater management structure that the local community installed in order to mitigate the environmental degradation associated with stormwater runoff. Specifically, the biofilter at the Charlottesville High School was investigated. The purpose of monitoring the water flowing into and out of the Charlottesville High School biofilter was to observe the filter’s impact on water quality. After analysis of the monitoring data, the team working with the RRBC confirmed improvements in water quantity and quality leaving the filter. Thus, the implementation of the landscaped biofilter in the school’s parking lot is beneficial. The efficiency of a best management practice (BMP) for stormwater runoff is determined by the design.

Stormwater flows from the parking lot through the biofilter and is released to Meadow Creek, a tributary of the Rivanna River. The water flowing from the parking lot is rich in nutrients. The biofilter is designed to absorb nutrients and decrease the volume of flow before exiting the biofilter.

The team of students contributed skills learned from previous stormwater management research by working with the RRBC in monitoring the Charlottesville High school biofilter. The RRBC
benefited from the skills and time contributed by the students who collected and analyzed the data during and after each storm. The samples needed to be gathered from the ISCO chemical samplers which can hold up to 24 samples per setting and the nutrient analysis must be completed within 24 hours after collection. Due to the volume of samples, the team expended copious amounts of time and materials in order to gather all the necessary data. With the students’ training, they were able to work the samplers and run the lab tests in order to examine the performance of the CHS biofilter and provide the RRBC with the data to evaluate the biofilter’s overall efficiency. The data gathered from the CHS biofilter are quantitative measurements which may help determine the impacts and sustainability of current and proposed stormwater management strategies in the near future.

The team’s presence at the CHS biofilter also brought stormwater management to the attention of the high school community including both schoolteachers and students. The interaction between the students and community members promotes awareness on the topic of stormwater management and the environmental impacts due to low impact development. The CHS biofilter is one local example of the greater movement to improve water quality across the state. The Commonwealth of Virginia is preparing to introduce more stringent stormwater regulations. The stormwater work accomplished in this project is directly related to the introduction of these new policies. The team presented and participated at the 2010 Virginia Stormwater Symposium held on October 21, 2010 in Richmond, Virginia which discussed the implications of the new policies concerning stormwater management.

The major limitation of the project was the lack of rain and storms, especially during the summer months. The unpredictability of the weather and the lack of precipitation proved to be a significant obstacle, given that the project was centered on analyzing stormwater. The biofilter at Charlottesville High School was completed during the month of June. Little rainwater was filtered through the newly constructed system during the summer, but the team continued to obtain and analyze data from storms occurring during the fall months. Although there was more rainfall than during the summer, some of the data was not as thoroughly analyzed and a smaller number of samples were tested for nutrients for a given storm because of time constraints. The limited data, however, proved beneficial by increasing the overall data set. The team is proud to conclude that the biofilter at the Charlottesville High School is functioning as designed and serves as a valuable demonstration of sustainable stormwater management.
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