Mwangaza Trip Report Spring 2014

Background

Dr. Carrie Bruce, Brianna Tomlinson, and Dr. Bruce Walker visited Kenya from March 16-21, 2014, to follow up on research activities and connect with Kenyan partners. During this visit, the team worked with inABLE staff members to observe students in classes, conduct focus groups with students and teachers, and connect a weather station to the computer lab at the Thika Primary School for the Blind. The team also met with administrators, faculty, and graduate students at Kenyatta University (KU) to discuss collaborative research opportunities among inABLE, Georgia Tech, and KU. Drs. Bruce and Walker had previously travelled to Kenya in October 2010 to visit area schools serving students with vision impairment and participate in stakeholder meetings with government and industry representatives.

Schedule

3/16 (Sunday): Arrived in Nairobi and checked in at Fairview Hotel.

3/17 (Monday): Left for Thika School at 9am. At Thika observing students in math and science classes at the primary and secondary schools. Also talked with science teachers at the secondary.

3/18 (Tuesday): Left for Thika School at 10am. At Thika meeting with inABLE computer lab staff and talking with math and science teachers.

3/19 (Wednesday): Left for Thika at 8am. At Thika conducting focus groups with students at primary and secondary schools. Also spoke with math teachers at the secondary. Bruce arrived into Nairobi late night.

3/20 (Thursday): Left for KU at 7:30am. At KU until 12. Delivered weather station to Thika and connected to computer lab. Carrie and Brianna left Nairobi early evening.

3/21 (Friday): Bruce met with teachers at Thika Primary.

Each morning before proceeding with daily activities, the team stopped into the Head Teacher's office (Mr. Jotham Makokha) to review the day's plan and debrief about the previous day's work. Mr. Makokha would approve and we would proceed to the computer lab to talk with the lab staff and prepare for the day. As part of our formal research relationship with Thika Primary and Secondary Schools, we obtained written documentation from the head teachers for the continuation of research, permission for a specific research protocol involving focus groups and interviews, and authorization to take photos, video, and audio for research presentation and promotion.

Primary School

We observed classes in math (6th and 7th grade), activities of daily living (mixed, lower grade, mild cognitive impairment), and social studies (7th grade). As we noted during our initial visit in 2010, most classrooms were furnished with chairs and desks for the students, a larger desk for the teacher, and a blackboard painted on the wall. The student desks were positioned in rows that face the front of the room where the blackboard and teacher's desk is located. The desks had storage in a bin on the front side and under the top surface for students to keep their materials. We did not observe students carrying these materials with them as they moved to their next class, but were told that students keep some of their class materials in their personal lockers at the dormitories. A majority of the classrooms had several windows on two opposing walls and did not have overhead lighting or electrical outlets. Students in these classes had a range of vision impairment and used print, braille, electronic, and manipulative materials during the lessons. Lessons were delivered by the teacher through verbal instructions and writing on the blackboard.

Figure 1. Student using a tactile tool to understand fractions. The slip of paper is divided into sections by an embossed series on lines.

In the math classes, students used a variety of tools to understand math concepts and perform math operations that the teacher proposed to them through verbal and written methods. These tools included braille books, slate and stylus, abacus, tactile representations, and pencil and paper. In the 7th grade class (Mr. Moses Kaniaru), there were 17 students (4 females, 13 males) with various types and levels of vision impairment. The teacher stood near his desk and wrote on the board while he talked about division of decimals and simplification by lowest common denominator. He asked students to carry out division problems at their desk using paper and pencil or slate and stylus. The teacher called upon a student with low vision to go through the division process at the blackboard. Students sitting at the sides of the classroom were less active during the math lesson (e.g., didn't raise their hands to answer, little use of books or other tools) than those sitting in the central rows.

Figure 2. Students sitting in a math class. One student is writing on the blackboard to answer a math question.

During the 6th grade class (Mr. Paul Ngechu), 13 students (6 female, 7 male) with a range of vision impairment were learning about fractions. The teacher moved about the room while explaining and asking questions. Students used several tools during the lesson including pieces of paper divided into portions by an embossed line and abacuses. The teacher used a hands-on technique with students, helping them feel and carry out operations with the tools. As students completed problems at their desks, he walked around and checked their answers. He also asked a group of low vision students to come up to the blackboard to review a written math problem and talk through their solution in front of the class. When we asked the teacher about the use of abacuses in this class and not in the 7th grade class, he stated that they had recently been able to purchase a small number of them and that his class received them while other classes had not. He also said that many of the students had not used an abacus in a long time or never used one, so he was having to teach them those skills in addition to the math concept.

Figure 3. Several students standing near the blackboard in a math class. The teacher is explaining a math concept to them.

Netbooks

During this visit we were also able to observe and talk with students involved in the inABLE pilot study on netbooks for taking notes, studying, and accessing electronic textbooks. This pilot study began in June 2013 when inABLE received 30 netbooks to explore their utility as a portable academic tool. The netbooks were loaded with Windows 7, MS Office 2007, NVDA, AMIS DAISY Playback software, Talking Typer, and ZoomText. They initially selected students in the 6th and 7th grade who had been in the computer training class for at least a year and demonstrated better than average computer skills compared to their peers. These students received instruction through the computer training program on how to operate the netbooks and use them for taking notes during class lectures. In January 2014, these students started taking the netbooks into the classroom with the approval of the head teacher and classroom teachers. An upcoming goal for the program is to send the netbooks home with some of the students during a school holiday to assess whether the families can support the devices at home and how the students use them for academic purposes.

Figure 4. Two students are shown using netbooks to transcribe the teacher's lesson.

Figure 5. A researcher is looking over a student's shoulder to see what he has been typing on his netbook screen.

We visited the 7th grade social studies class to see the students using the netbooks. The teacher (Mr. Sami?), who was blind, recited from his braille textbook so that the students could transcribe the text by handwriting, Perkins Brailler, slate and stylus brailling, or typing on a netbook. The textbook was titled, “Physical Environment” and covered earth science topics such as weather, climate, geography, agriculture, culture, and planetary movement. The teacher occasionally asked questions related to the text, but spent a majority of time dictating in a slow and repetitive manner in order to help the students keep up with transcription. Four of the students (2 low vision, 2 blind) in this class used netbooks to take notes during class. These students sat in the center row of the class. They had binaural headphones for listening to the text as they typed, but only one student was seen wearing them on his ears during the entire lecture. The other students either wore them around their necks or kept them on the desk for all or most of the lecture. We observed that a couple of the students using the netbooks received assistance from the computer lab staff due to difficulties operating the netbooks. One of the students with low vision had problems opening the correct file to type in and the other repeatedly inserted text in the wrong place because his palm and wrist rubbed over the trackpad as he typed. The latter student was frustrated with the errors in his typing and could not keep up with transcribing the lecture. After a student finished the lecture notes, they were saved to a web-based shared file that the lab staff can access in the computer lab. The staff can clean up the notes and assist the student in making corrections during free time in the lab.

After the observation, we discussed the netbook project with the inABLE staff to understand the successes and challenges they had identified. One major hurdle was access to electronic textbooks and text-to-speech (TTS) reading. They had purchased one of the approved textbooks through Amazon and could get it through the Kindle software. On an iPad with the Kindle app, the iOS VoiceOver feature was able to read the text aloud. However, on the netbooks with the Kindle software, the NVDA screen reader could not read the book aloud and there was not another TTS option. The inABLE staff had created a workaround by copying the text from the electronic textbook, pasting it into a Word document, stripping the tables and figures out (since these do not have descriptions), and using NVDA to read the new text document. This is a lot of extra work for the staff and they do not generate any descriptions for tables or figures that are omitted in the workaround.

Figure 6. A researcher talks with an inABLE staff member about netbooks.

They have also run into concerns from teachers regarding the loss of braille skills with the increased use of keyboarding through the computers. The teachers reportedly would prefer for the students to take notes in braille to get practice in producing text so that they do not forget how to read it. Additionally, the teachers do not want the students using netbooks to be slower in taking notes than those using Perkins Braillers. The teachers have also mentioned that they are afraid that the district education officers would not be supportive of students using the netbooks in class. These officers can visit the school at any time and the teachers do not want to "get caught" doing something that has not been approved.

The lab staff has yet to collect data on keyboarding skills and typing rates as a way of addressing device (netbook vs. brailler) comparison questions, determining student progress, or evaluating effectiveness. The GT researchers made this suggestion to the team in moving forward and scaling up their project. Furthermore, in talking with the lab staff about the process of cleaning up and editing students' notes, they mentioned that they do not save the original version of the notes. We discussed how it might be useful to save these in another effort to track errors and students' progress.

We conducted two brief discussion groups (n=5; n=6) with the students using the netbooks. During this meeting, the students identified benefits and challenges of using the devices for notetaking, homework, and studying. Key points that they made included that keyboarding on the netbooks requires less physical energy compared to typing with a Perkins Brailler and editing their notes is more efficient on the netbooks and doesn't waste braille paper. We also talked about the upcoming pilot study for sending the netbooks home with them. They anticipated that having the netbooks at home would make it easier for them to study and that their family members and friends could help them because the information was in visual text or text-to-speech, and not in braille.

Figure 7. Researchers and an inABLE staff member talk with students about learning challenges.

We held discussion groups with math and science teachers at Thika Primary to get their input on using sonification and auditory display to teach math and science concepts. Brianna met with the math teachers to demonstrate the Sonification Lab's GNIE (Graph and Number line Input and Exploration) software and get feedback about its design and utility. The teachers had lots of questions and gave suggestions for improvements. One of the main suggestions made by the Thika Primary teachers came from the fact that some of the teachers are blind or low vision, and so they would need a better description overall, through thorough documentation, about the system and the chosen sonifications for the graph. GNIE was designed for a use by a sighted teacher, and the new user group will require adaptations to the current system, such as giving non-visual feedback when adding a new question, when files are loading, and other situations where there is only currently visual feedback. All of these circumstances are for when the teacher is initially creating questions within the system, and implementing auditory display for such circumstances is a necessary next step. The teachers also asked for examples of how to create questions focused on specific topics (e.g. performing addition and subtraction using the number line, computing area and perimeter) and they asked for examples of different questions that previous teachers using the system have created. Overall, thorough documentation is needed to familiarize new users with GNIE, especially since teachers must become accustomed with the system before than can use it in the classroom context.

Figure 8. A researcher talks with teachers about a sound-based math application that GT has developed.

Carrie met with teachers who taught science in the 3rd, 5th, 6th, and 7th grades to talk about weather and space concepts. The teachers discussed basic concepts such as pressure, temperature, and wind speed and how they convey those concepts to the students. They have few tools to use in teaching about science and mostly talked about real world experiential learning. For example, they talked about how many of the students are familiar with rain based on feeling it and hearing it on the metal roof of the school buildings. They also talked about blowing a balloon up to demonstrate increasing pressure and deflating it to show decreasing pressure.

Figure 9. A researcher talks with teachers about ideas for teaching weather and space science content.

Secondary School

Carrie and Brianna both observed the Thika Secondary School's chemistry and physics classes. The chemistry teacher began class with discussing how physical and chemical processes create energy transfer. She started by standing at the front of the classroom, at the chalkboard, and lectured about the topic for the day, then she had the students break up into groups of 3-5 students, copy down the experimental method which she read out of a textbook, and then they performed the experiment while the teacher walked from group to group checking on the students and answering questions. No blind students attend the chemistry class, even though some students with low vision do.

Figure 10. Students are shown during a chemistry class conducting a lab activity.

Then we performed a classroom observation for the physics class at the Secondary School. Throughout the duration of the class, the teacher stood at the front of the room, and worked through problems on the board after he selected a student to read it out loud. The teacher encouraged the students to answer portions of the problem, and only when they became confused or did not understand how to proceed, he would complete similar problems on the board. Also, once the class covered three or four problems together, the teacher would call a student up to the board to complete a similar, but more complicated, problem. No blind students attended the physics class, as well.

Figure 11. Several students sitting in a physics class while the teacher discusses concepts at the balckboard.

Carrie met with two biology teachers from the high school. They talked about the problems with concepts that are typically conveyed through diagrams such as the food chain or parts of a plant. Some of the difficulty is with the inability to show detail or complexity in relationships through their embossing/thermoforming techniques. They are limited in what can be tactilely represented and identified as a static display and have no option for something more dynamic or interactive. They talked about how a computer program may be able to help them overcome some of these problems. The teachers also talked about the difference between the tactile representations they are able to create at the school and those that come with the national exams. At the school, they produce master tactile diagrams that are comprised of braille labels, sticks, string, sand, and other at-hand materials. The masters are then copied by thermoforming so that students can have their own or share diagrams. Thermoforming tends to be more durable for the students, but it has limitations in how many different features it can represent. The tactile diagrams that come with the national exams are embossed through an embossing machine. The differences between the materials that the student learns with in the classroom and what is presented on the exams is sometimes significant. For example, an embossed diagram on an exam may have different types and level of detail in its tactile attributes. The teachers also reported difficulty with diagrams that show perspective in the original visual form such as an image of a tooth and diagrams that show relationships among components through lines that cross each other or indicate direction.

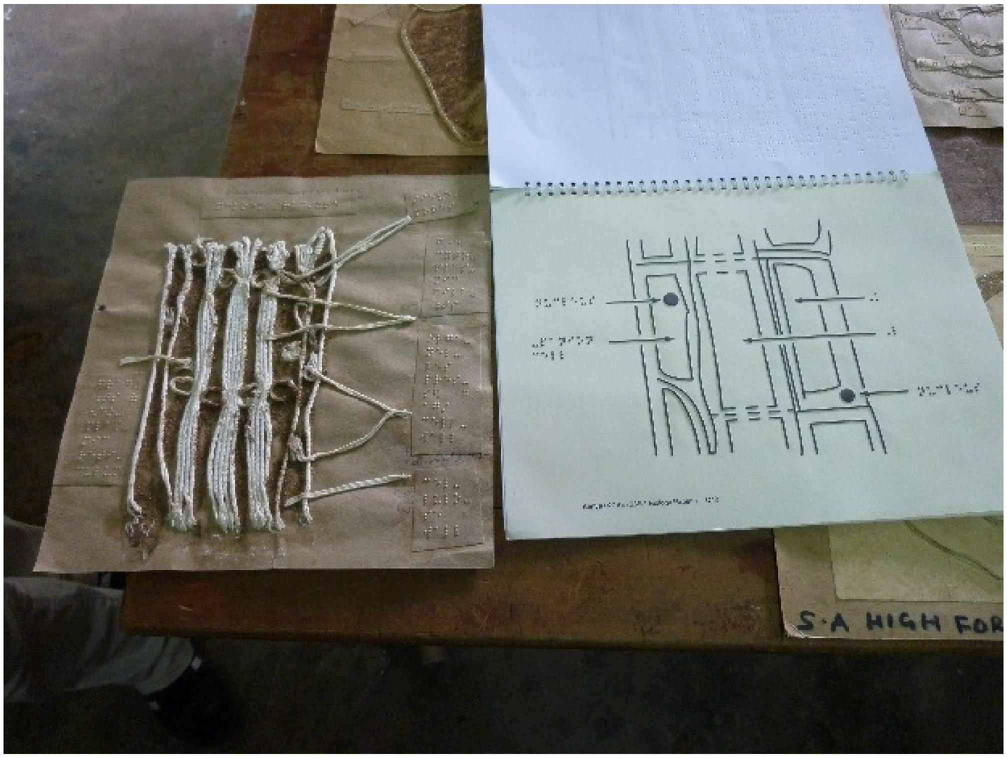

Figure 12. Examples of tactile diagrams representing the structure of a plant stem. One diagram is made of strings and has braille descriptions. The other diagram has been embossed with a special printer.

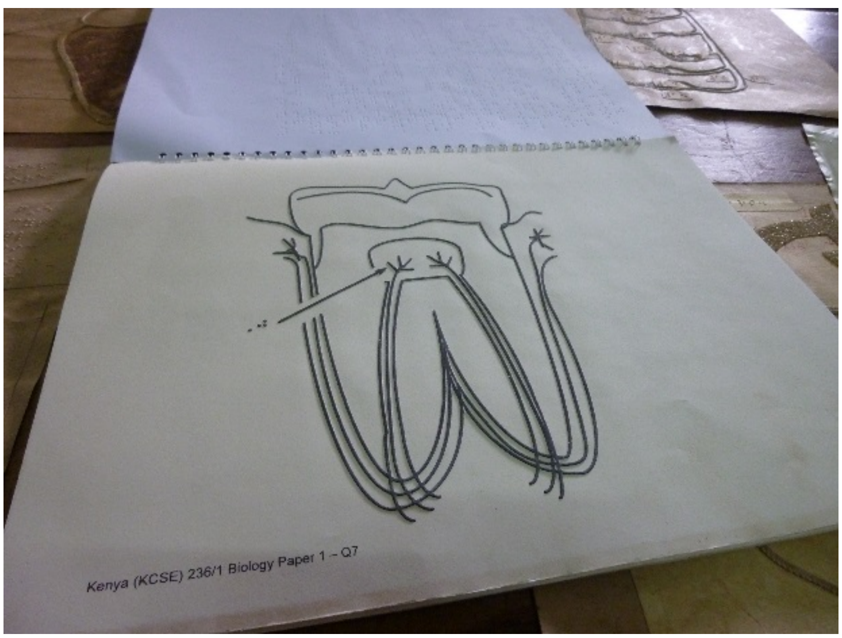

Figure 13. An example of a tactile diagram. This diagram has been embossed with a special printer and shows the parts of a tooth.

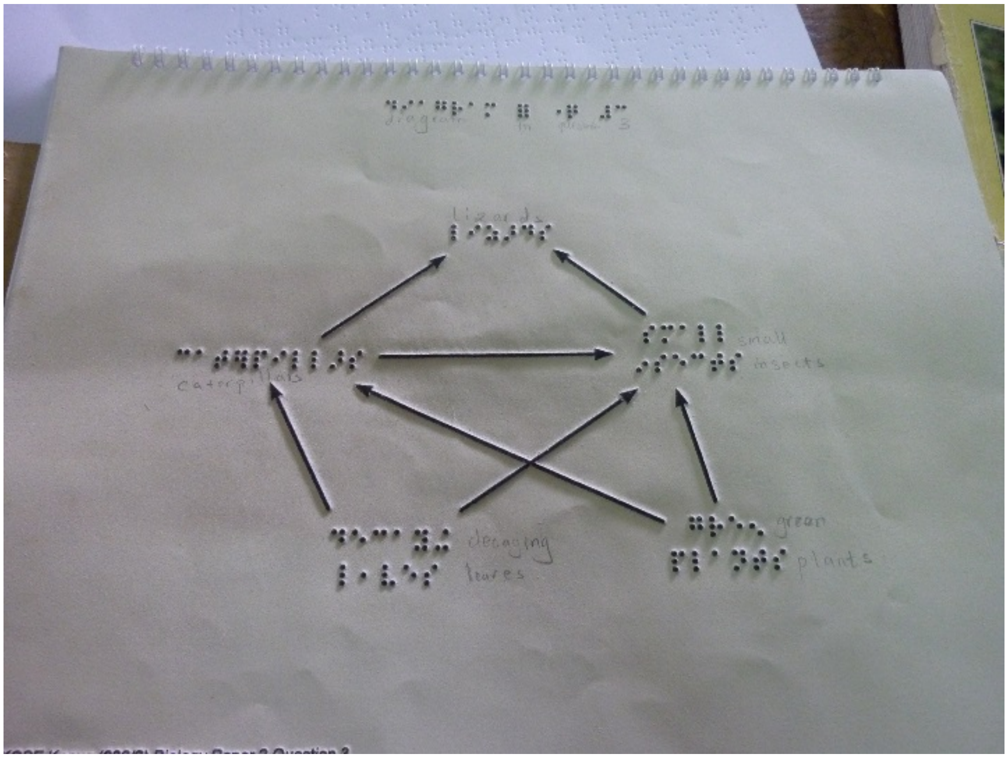

Figure 14. Example of a tactile diagram. This diagram has been embossed with a special printer and shows relationships between plants and animals.

At the same time Carrie met with the biology teachers, Brianna the Secondary School math class, taught by the same teacher as chemistry. During this class, the students focused on combining multiplication, division, powers (e.g. $(x^2)^2$), and logarithms into complex equations to solve. The teacher walked up and down the aisles of the class and would read out a question, then ask the students to solve it. Many students had braille copies of the text book, *Advancing in Mathematics Form 2*, some students used a pen and paper to complete questions, a few used a slate and stylus, and many students used a Perkin's brailler. In order to solve the problems, the students used tables and charts to search for the estimated number value for the power and logarithm computations to solve the given question. None of the students had access to calculators to use in the class. As the students completed questions, the teacher would ask for them to read their solution out loud, and she would walk around the classroom checking their work.

Brianna also met with the Secondary School math teachers to give a software demo of GNIE, and to hold a discussion with them about possible areas of improvement for the system, as well as give examples for how to utilize the software in the classroom. One topic brought up was at the secondary school level students need to be able to perform math in 3D (on the X-Y-Z axes), currently the software only works in 1D and 2D and would need to be expanded to handle the more complicated graphing. They also discussed the need to teach about graphing curves, or calculating the midpoint and questioning the students about it. Another suggestion they asked for was auto-describing the given graph, instead of a teacher needing to type an entire description into the question area of the software. Finally, after giving the software demo at Thika Primary and Secondary Schools, it demonstrated the need for a user guide and documentation to give to teachers to describe the different functional capabilities of the system. Many of the math teachers at Thika Secondary also teach a science class as well, and they inquired about other computer tools or software they could incorporate into the classroom to engage students and help teach.

Students at Thika Secondary take a computer skills class as well, using desktops, to learn typing and other technology-related skills. We conducted two focus groups (n=7; n=9) with students who had taken a survey about computer and how they felt about computers the previous summer. During the focus groups, we asked about the rating scale used by the students to answer questions, how to best word questions to reduce confusion about terms utilized, and how the students interpreted the different questions asked in the survey. The students emphasized how important they felt computers were to having a successful future (their usefulness as a marketable skill, a way to become independent, and a way become informed on a variety of topics). Many of the students discussed ways to keep learning computers competitive and interesting, as well as finding ways to continue to use computers in further schooling, or as a way to find a job after they graduate.

Figure 15. Researchers meet with groups of students to talk about their experiences in learning about and using computers.

The final focus group we held at Thika Secondary School was for girls who participated in the survey the past summer and who attend the computer skills class. During this focus group, we wanted to find out more about how girls feel about technology and look for why some of them are engaged in the computer classes and why others are not. When we asked about why the girls attended the computer training, they emphasized that they come because they think it is interesting, important to learn because it benefits them, and that they consider it to be similar to any other class. Many of the students who attend the computer classes are visually impaired, and while they said it was harder to learn the keyboard, and might initially be intimidating to learn slower than the boys or slower than sighted students, that the NVDA screen reader helps to mitigate these problems. We wanted to learn what makes the girls interested in learning about technology, and we got a variety of responses from the students, ranging from being able to use social media to communicate with friends (Gmail, Facebook, etc.) to being able to explore concepts or ideas mentioned in class to a more in-depth level to learning skills useful for working or owning their own business after they graduate. When we asked what other technology or skills the girls wanted to learn, some ideas they suggested were learning more about IT certification, learning about computer security, and learning how to video chat. Even though many of them are the first women they know who have knowledge about computers, they showed how excited and interested they were to continue learning new skills.

Figure 16. Female students talk about the challenges they face and their interests in learning to use computers.

We held a meeting at Kenyatta University on Thursday, March 20th to make introductions with institutional administrators and discuss research opportunities with the Special Needs Department. We started at the main building KU Admin Building and met with Dr. Vincent Onywera, Dr. Nelly Otube, and Mr. Paul Waithaka. After getting an overview of Kenyatta University's campuses and Schools, we moved to another meeting with the Special Needs Education Department. Dr. Otube led this meeting with presentations by Dr. Walker and Irene about ongoing projects and research opportunities. Faculty and students from the Special Needs Education Department attended the meeting and asked questions. They were interested in gaining access to computer resources within their department and identifying ways of making chemistry and physics accessible for students with disabilities. When GT described the challenges that students who are blind face when they take the national exams and that we should determine a strategy for teachers of the visually impaired to provide input on the design of text questions. The KU faculty mentioned that the Kenya Exam Council would be the contact organization and that they could follow up to find out more about the exam design process. The group also talked about the potential roles and responsibilities of inABLE, GT, and KU in building collaborative research projects. KU said that they could create a research committee that would oversee projects. We agreed that the initial group project should be to prepare and conduct a follow-up to the baseline survey performed at Thika Secondary in May 2013.

Figure 17. Researchers from GT and Kenyatta University meet to talk about the Mwangaza Project.

Weather Station

Prior to this trip, we arranged with the Weather Underground company to donate a RainWise MK-III weather station ($959.00), mounting hardware ($40.00), and the shipping costs to Kenya ($540). RainWise arranged for the shipping and it was sent out March 5. It arrived in Nairobi around March 14, but was hung up in customs for taxes and fees. After much negotiation on the part of inABLE's staff in Nairobi, we paid an additional $750.00 to pick up the shipment and drive it by taxi to Thika on March 20. We determined that the most secure and sturdiest location for the weather station was on the roof of the computer lab building. We connected the weather station to a computer in the lab and registered it with RainWise and Weather Underground. The lab manager (Peter Okeyo) was given instructions on how to access the data on the Internet. The school did not have a useful ladder for mounting that day, so they hired a local person to come the following day and install it.

Figure 18. Researcher are shown presenting a weather station to an inABLE staff member.

Figure 19. The weather station is shown mounted on the computer lab building near the roof at the Thika Primary School.