How To Fix The Machinery of Health Care In Rwanda

Geographics: Design, Education and the Transnational Terrain

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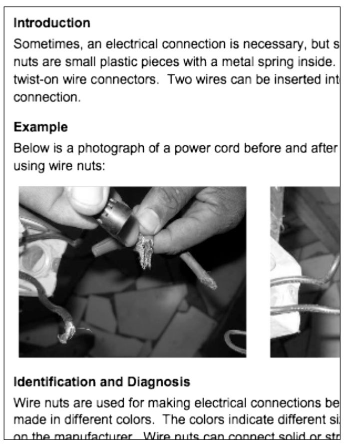
In developing regions of the world, the quality of medical care is dependent upon properly functioning diagnostic equipment. Often this equipment is donated or otherwise obtained without a service contract or staffed with trained personnel to repair it. A stethoscope may be unusable due to a simple blockage, or a very expensive piece of medical equipment inoperable because of an easily repairable electrical connection. A Duke University Biomedical Engineering team developed an extensive series of teaching aids intended to train biomedical engineering technician's assistants (BTA) to identify, diagnose and repair medical equipment.



Introduction
Sometimes, an electrical connection is necessary, but s
nuts are small plastic pieces with a metal spring inside.
twist-on wire connectors. Two wires can be inserted int
connection.

Example
Below is a photograph of a power cord before and after
using wire nuts:

Identification and Diagnosis
Wire nuts are used for making electrical connections be
made in different colors. The colors indicate different si

Original lessons written and formatted in English with a word processor with sparse photography

As a unit in the BTA's curriculum, the lessons were structured and written for students in places like Rwanda and other developing areas of the world. Using the techniques acquired through the BTA lessons, Duke estimates that over sixty percent of medical equipment failures could be easily remedied by trained, local BTA's. However, while the lesson materials were rich with descriptive content and some dubious photography, they fell short of depicting clear, step- by-step diagnostic and repair procedures. And, in fact, the lessons relied primarily on the written word to convey complex tasks. While English is an appropriate second language for the lessons in many places of the world, it is not the ideal method in which to communicate the material. We discovered through the design process that the diagnostics largely depend on a visual evaluation of a problem, and the solution is a manual operation. Both phases, visual and manual, also require just enough specialized knowledge and skill to complete the repair. Instead of relying on the written word to describe these complex tasks, we explore kinesthetic learning using the best methods for the visualization of the diagnostic and repair scenarios.

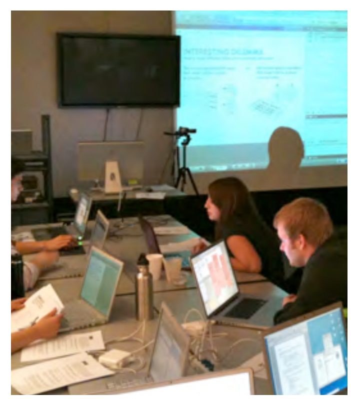
Lessons teach diagnostic and repair technique for to medical equipment

For this project, the client recognized early on that design would play a crucial role in developing highly visual educational materials—a skill set they lacked. Our collaboration depends on the client having a significant appreciation for the application good of visual communication. Conversely, to be effective designers, we would have to work closely with

BTA students in Rwanda video conferencing with digital design students at the University of Cincinnati

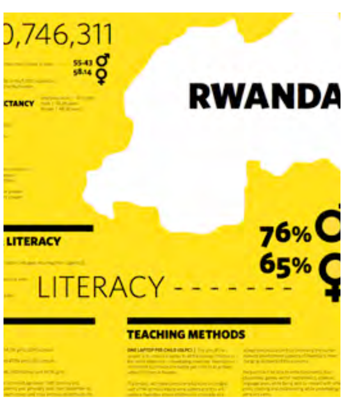
the client in order to communicate specialized information accurately and effectively to a distant culture. Too often design is simply left out of this process, or designers are brought in at the last moment to “clean up” the final product. This presents a unique opportunity for UC students to design on a global stage: 1) engage with a client (Duke) with technical expertise and knowledge; 2) address an audience who has limited access to the expertise, information, and technology necessary to complete a variety of maintenance and repair tasks because of their location in the world (countries like Rwanda).

The transnational aspect of the quarter-long project is also manifested in the information gathering, research and presentation phases. The classroom studio is transformed into a two-way video conferencing center using a standard HD video camera, microphone and projector so that the class may visit directly with the experts at Duke, a teacher and a group of students in Rwanda, a doctor (and Doctor Without Borders volunteer) in Columbus, and the illustrators responsible for instructional guide standards at IKEA. Though experiencing the conditions in Rwanda first hand would have been valuable, it is fortunate that technologies like Skype, iChat and WebEx create a virtual relationship with our intended audience for the class.

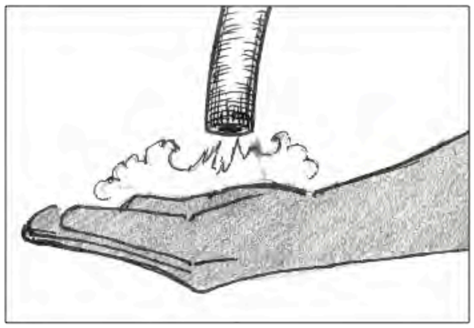


(right) UC students sharing concepts with IKEA representatives

The innovation is not necessarily in the design exercises themselves, however, the cumulative design process engages these digital design students' skills in novel and creative ways. It was both necessary to understand a distant population for whom we were designing and grapple with depicting instructional procedures that involved technical skill and medical knowledge. Data was collected about our Rwandan user concerning culture, language, literacy, technology, education, future aspirations, career goals and learning style from interviews and the literature. It was then presented and shared. It was also possible to connect our classroom with Skype video conferencing to an in session BTA class. We learned a great deal about



Student teams research Rwandan culture and design panels to share with the class this group of people in the small African nation of Rwanda. The similarities were most striking. The group of Rwandan BTA students is the same age or a bit older than the UC students pursuing a technical degree for job opportunities—not unlike the design students



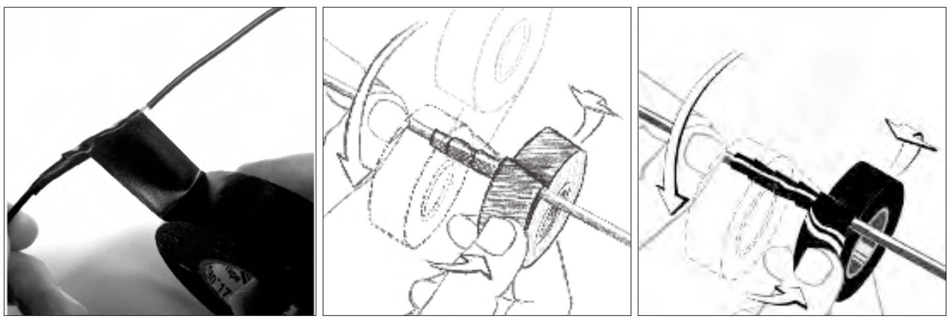
Sketching and storyboarding of "action frames" that reveal procedure (J. Sikorski)

at UC. While we may have been hoping to discover striking differences in culture to apply to our design, our method of visualization seemed to generalize the subject matter to avoid cultural bias. We learned of a few unlikely hand gestures to avoid, and because of technological constraints, we are already avoiding the use of color. Otherwise, our client describes our audience as highly visual preferring bold graphic displays over text and imagery. We were able to ask about the current materials before the redesign, and the answers were all very positive. According to the instructor, an Engineering World Health volunteer, it is it necessary to probe further because our Rwandan BTA students are exceedingly polite and will find it very difficult to say anything negative especially concerning anything related to the instructor or anyone in a position of authority. The dialog with intended audience is quite useful as design research, and additionally, students will experience a sense of entitlement to the project knowing there is real potential for the designed solutions.

Photographic reenactment of the lesson step-by-step with actual props or realistic and creative substitutes (J. McAdoo, M. Fox, S. Meek, R. Brilli)

(right) Exploring methods of representation and appropriateness for our audience (A. Appiarius)

The next step is to understand the repair and diagnostic procedures through "reenactments." Students gather tools, materials and sometimes props to capture a visual record of a procedure. The act of reproducing the conditions in the lesson is essential to understanding the motions and actions that need to be depicted. Not many of the students have experience with the tools and procedures in the lessons, and reenacting the lesson gives them insight to and empathy for the intended user. As they work through the lesson in teams, photos are liberally taken of key moments and then edited together with a voiceover of the lesson text. The resulting animatic is the basis of the narrative, which is becoming an increasingly more important skill. Although not a narrative in the sense of a story, it is still a procedure that unfolds through a series of carefully composed, framed and timed shots. Additionally, the reenactment is used as reference throughout the design phase especially when dealing with challenging perspective and compositions of hands and bodies. Through the process of creating reenactment, the students can not only fully understand technical aspects of the subject matter, but also are able to devolve it into a simplified and comprehensive storyboard.



Design process: reenactment, sketch development, digital illustration (A. Fite)

Then comes the design phase. Students are tasked to look into the various aspects of a procedural narrative and evaluate the effectiveness of elements of representation: figures, objects, environments. This could include, for example, the best practices concerning vantage point and the sequence of shots or the depiction of force applied by a hand or tool. Storyboards are sketched, hand rendered and then combined with digital media through an arduous process (digital designers are not necessarily keen on reviving hand techniques). In nearly every student’s case, the humanistic expression of hand drawn renderings carries through to the digital version. The final storyboard is an image sequence without supporting instructional text. We chose to evaluate the efficacy of the storyboard as a complete instructional guide for the user who may have little experience with English. In

Exploring methods of representation including the depiction of force (A. Walton)

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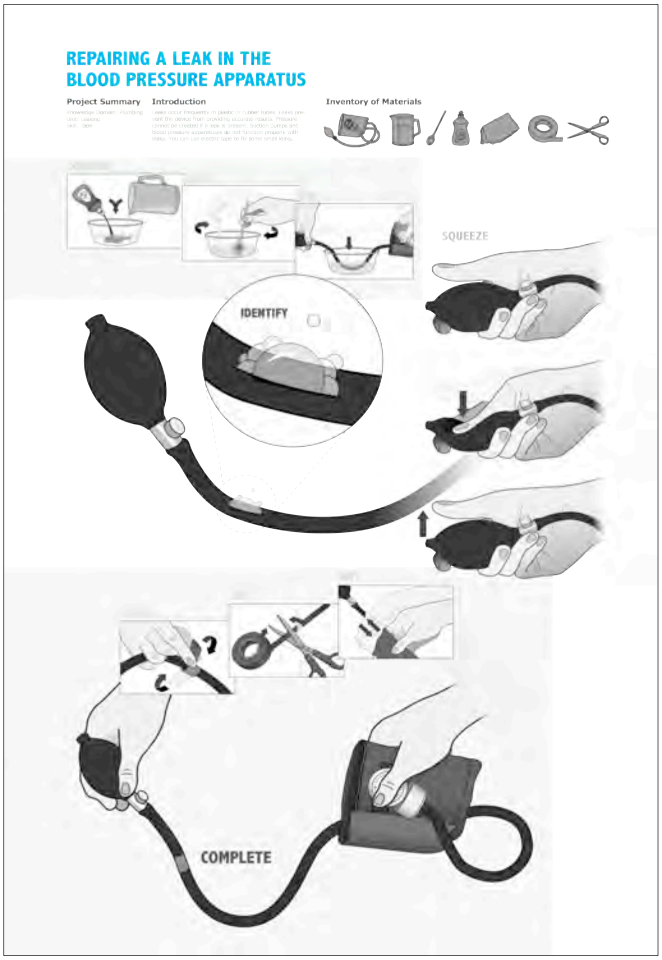

Integrated solution poster with minimal text for repairing a blood pressure apparatus (R. Brilli)

the final version, the text will reappear, but in this interim step, eliminating it helped to reveal issues especially with the transitions between the steps. This raw storyboard is then shared with our new colleagues at IKEA for feedback concerning the formal and functional aspects of the compositions.

Now with a refined storyboard, the students are able to consider an integrated solution of imagery and text within a hierarchal layout. Because the end user may not have access to technology, the final iteration of the storyboard is a paper-based lesson that will appear in the course materials for a biomedical engineering technician's assistant in a developing country. For the deliverable to be presented to our client, we explored methods of structuring the lesson for both the classroom and as part of a reference the BTA will take with him on the job. The class also explores other, forward-looking methods of delivering the information, but traditional media must be part of the solution. The project concludes with a presentation to the client, and the delivery of designed materials for testing on site in the Rwandan classroom.

By hyper focusing on the translation of word to image, rather than breakthrough technologies, the combination of teaching methodologies, transnational collaborations and design processes yields results that surpass many examples of pictorial

Integrated solution binder insert for proper use of electrical tape (B. Cushing)

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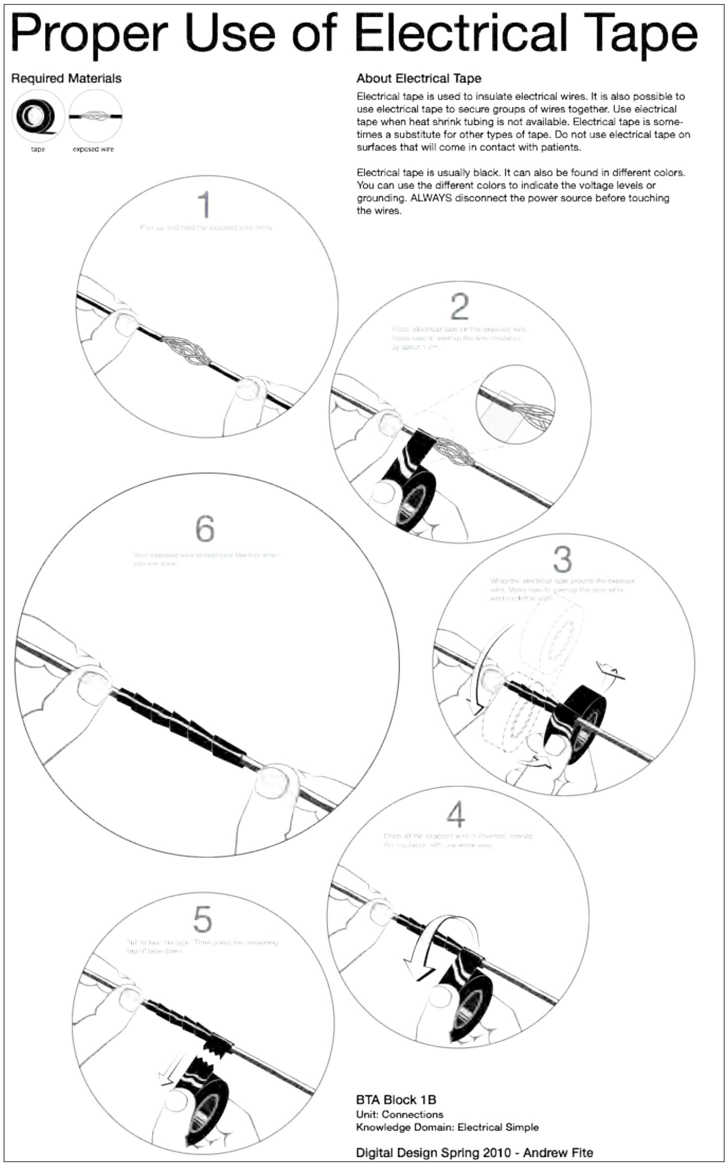

Integrated solution poster for proper use of electrical tape (A. Fite)

instructions that pervade our life. Because the design must be universal, so much care is given to the clarity of visual communication to avoid the crutch of a single written language that the true innovation lies in the quality of the depiction and the narrative sequencing of shots. Perhaps there is addition motivation for a designer who could affect the operational quality of medical equipment for disadvantaged populations, but there are details in the student's work that represent great examples of what visual communication design has to offer as a discipline.

As a concluding thought, it is important for me to relate that this is one of the more ambitious classroom projects that I have attempted. It takes the support and effort of a great many people I would like acknowledge not only to give credit where it is due, but also to convey the behind the scenes structure of the relationships. The project originated as a query for design assistance to then Director of Design Professor Mike Zender at the University of Cincinnati. We then made a connection to Dr. Robert Malkin, Professor of the Practice of Biomedical Engineering Director, Developing World Healthcare Technology Laboratory at Duke University. He and his Technical Assistant Lora Perry provided us with the project details, background and the finalized copy of the written course materials. Through Duke, we made contact with their “man on the ground” Billy Teninty, an Engineering World Health Program Officer teaching in Rwanda. Billy provided insight about his students, setup the video conferencing, tested the designed solution and provided

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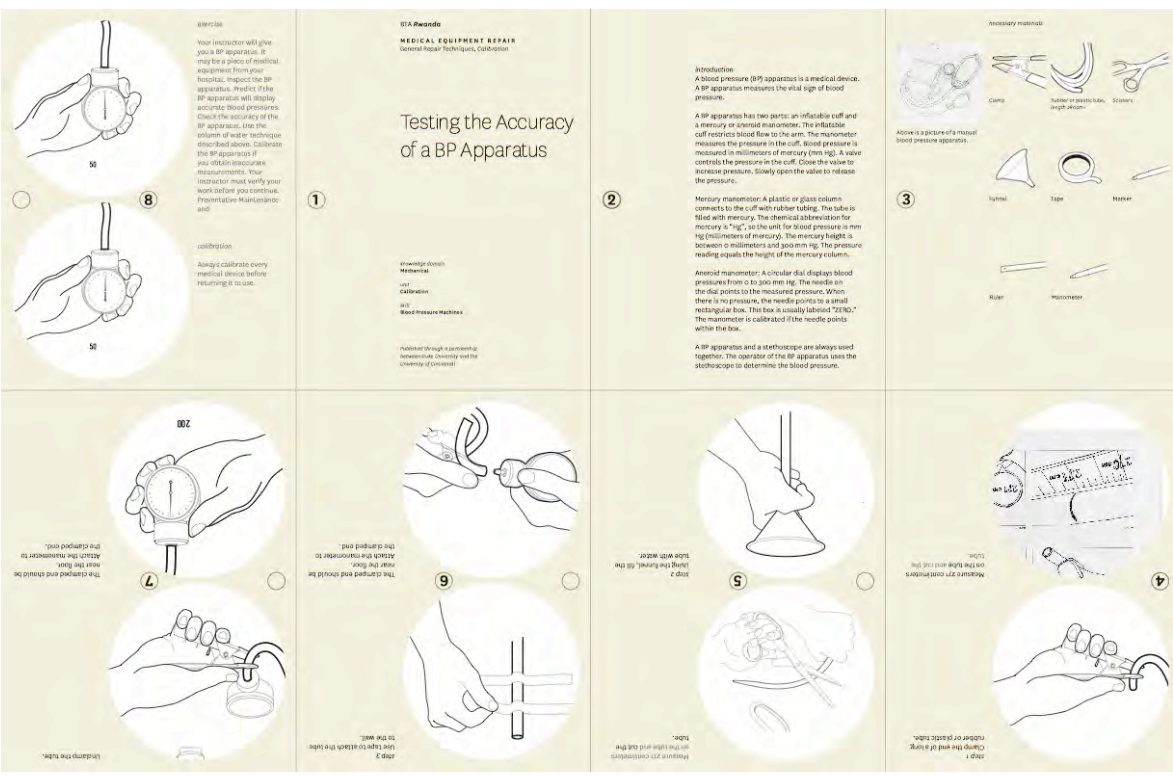
feedback. Professor Oscar Fernández took the lead on contacting IKEA and arranging an interview with the team that produces all of IKEA's assembly instructions, and as program coordinator, he adjusted class scheduling so that I could continue this project in summer quarter for the other section of juniors. I was also loaned a graduate student teaching assistant, Marnie Meylor, to help manage the class and teach a complimentary class in summer. Finally, my thanks to all the students produce a range of solutions thinking very deeply about the design problem; a total of thirty-three students with thirty-three thoughtful options.

Project update from R. Malkin, Duke University: "In a matched-pair study, hospitals that had been trained to use the BTA skills reduced their out of service equipment by nearly half."



Integrated solution pamphlet for testing accuracy of blood pressure apparatus (A. Fite)