

An Investigation into and Recommendations for Appropriate Technology Education

by

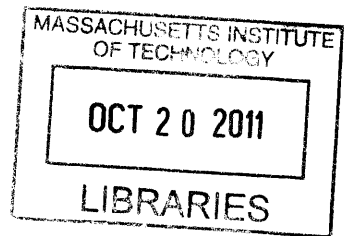
Amanda J. Grue

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Signature of Author: _____
Department of Mechanical Engineering
May 6th, 2011

Certified by: _____
Maria C. Yang
Robert N. Noyce Assistant Professor of Mechanical Engineering and Engineering Systems
Thesis Supervisor

Accepted by: _____
John H. Lienhard V
Samuel C. Collins Professor of Mechanical Engineering
Undergraduate Officer

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Amanda J. Grue

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Abstract

The purpose of this paper is to present an example of appropriate technology (AT) education in a university setting, and make recommendations for using open source technology to aid AT education (OSAT). This paper presents a brief overview of the AT movement, and defines critical criteria for creating and implementation solutions for the developing world using this approach. The International Development Initiative (IDI) at the Massachusetts Institute of Technology is described in detail as a model example of efforts to promote the study of AT in higher education. OSAT is investigated in further detail to prove validity as a new aspect of the AT movement and a course of study incorporating the use of OSAT is developed to aid educators.

Thesis Supervisor: Professor Maria C. Yang

Title: Robert N. Noyce Assistant Professor of Mechanical Engineering and Engineering Systems

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1. Introduction

“Appropriate technology is technology with a human face,” claimed economist E.F. Shumacher in *Small is Beautiful*, the book that started the appropriate technology (AT) movement (Shumacher 1973). The idea that labor-intensive, small-scale technologies could be used for development work both locally and internationally was new to the engineers, economists, and developers of the 1970’s (Morris 2009). The formation of an approach which depended on self-reliant technologies and their use in improving the lives of individuals and communities in developing regions allowed for the growth of development organizations in the U.S. and internationally (Morris 2009). However, the movement was short-lived, and in the early 1980’s, many of these organizations shut down (Morris 2009). Today, new forms of AT promotion have sprung, leading to a reinvigoration of the movement that believed in the value of finding appropriate solutions to real problems in villages across the world. These new forms of AT include Open Source AT (OSAT), and the use of AT in engineering and development education. With a consistent criteria for AT solutions, and new ways to promote the AT approach, the movement that once was a political and national agenda can once again be an organized approach to aiding the communities in the most effective way possible.

This paper serves to present the history and goals of the original AT movement, outline new methods of promoting the AT approach, give distinct definition to the AT criteria, present a case study of AT education at the Massachusetts Institute of Technology, and provide suggestions for modifying existing forms of AT education to best preserve the ideas and methods that have led to a holistic and humane approach to development.

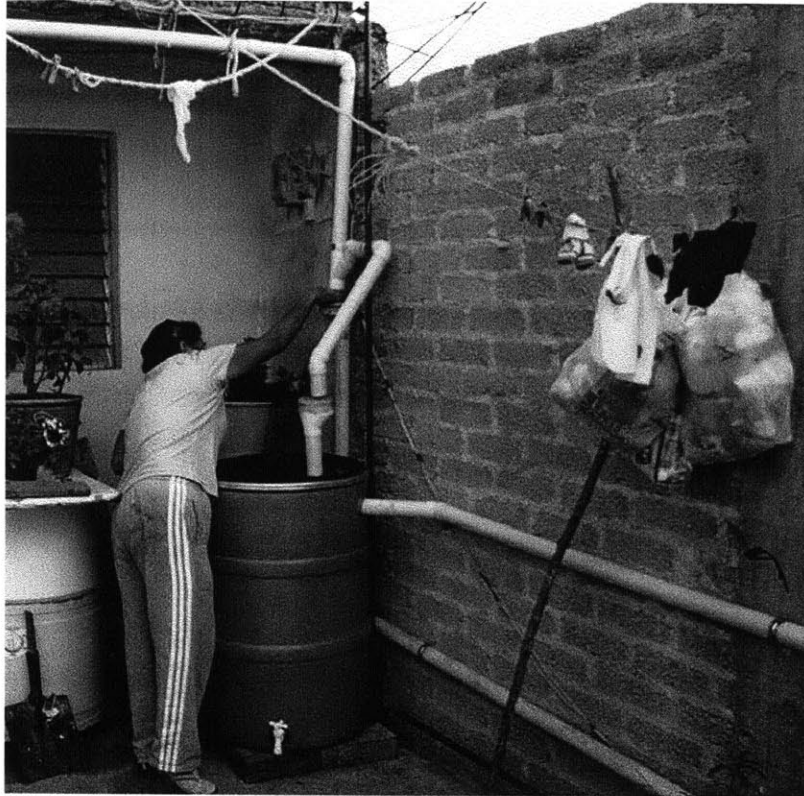


Figure 1: *A resident of Mexico City using a rainwater harvester developed by the nonprofit Isla Urbana. The appropriate technology design provides accessibility to clean water for urban dwelling families in Mexico City and other regions of Latin America. (Appropedia.org 2011)*

2. Designing Appropriate Technology

2.1. The Appropriate Technology Movement

Appropriate Technology can be defined as technology that is created with special consideration to cultural, ethical, political, economic, and environmental factors within the community it is intended for (Bull, “Field Guide” 2003). AT must require less resource: capital, energy, manufacturing, in order to create affordable solutions that can be acquired and maintained by individuals, households, or communities (Bull, “Tools, Choices” 1998). AT

therefore focuses on more labor-intensive technologies, which often utilize the most basic solution to the problem (Farooq 1988). These labor-intensive technologies should also be organic solutions that utilize the people, materials, and structure of their intended communities. AT can also use advanced and recent technologies that replace existing inefficient or dangerous technologies used in the developing world (Bull, “Field Guide” 2003).

Appropriate technology stemmed from the work of economist E.F. Shumacher in the 1970’s, most notably his book *Small is Beautiful: Economics as if People Mattered*. Shumacher challenged the concurrent ideology suggesting the “transfer of technology” was the most important step in promoting the continued development of poorer countries (Shumacher). Shumacher argued to design for sustainability and permanence rather than technological growth which did nothing to serve the needs of humanity. Shumacher believed in an evolutionary approach that provided development on the heels of education and substantial foundation for developing nations to maintain and take over technologies. *Small is Beautiful* coined the term *intermediate technology*, which described the intermediate position between capital-intensive and labor-intensive technologies. Shumacher also brought in the idea of considering who the intended community is and what their specific needs are, eventually morphing the idea into what is now considered to be an *appropriate technology* approach to aiding developing nations. Although Shumacher was not the first to use the term appropriate technology, it gained wide use due to the popularity of his collection of essays on development (Morris 2009).

With the beginning of the intellectual movement toward appropriate technology, many national and independent organizations focusing on AT development sprang up shortly after the release of his book (Morris 2009). Experts on this type of development were in demand (Darrow 1979). These organizations lasted several years, the main U.S. organization being the National

Center for Appropriate Technology (NCAT). NCAT lasted several years during the height of the AT movement, fueled by an increased awareness of sustainability and poverty issues in America due to the oil embargo in the mid 1970's—however, in in the early 1980's, the best known AT organizations shut down to due lack of funding during the Reagan administration (Morris 2009). Many factors contributed to the decline of the AT movement, although Carol W. Pursell, Professor of Modern History at Macquarie University in Australia (who documented the history of the AT movement in her essay, *The Rise and Fall of the Appropriate Technology Movement in America*) claimed that although the overhead organizations promoting AT ceased to exist, the underlying ideologies of sustainability and reduction existed to continue small scale efforts (Pursell 1993).

Today, it is estimated that 80% of the human population lives on less than \$10 per day, and the poorest 40% of the world's population accounts for just 5% of the global income (Shah 2011). It is necessary then, that AT is revisited as an effective and appropriate way for engineers and developers in the U.S. and other developed nations to aid the building economies in developing nations. A significant method of reintroducing the AT movement is through education—where by either funded visits to developing nations or through means of open source databases, universities can and should provide students with the necessary education to design appropriate solutions for communities around the world.

2.2. Current and Future AT Ventures

Although these efforts did not scale during the period after the decline of the AT movement, recent distinct efforts have been developed. Two main tools for promoting and scaling the use of AT in development work exist today:

- 1) Utilizing open source appropriate technology (OSAT)
- 2) Educating future engineers/developers with the AT approach

OSAT can be important both in the open exchange of knowledge that aids others working to promote the AT movement, as well as in the education of future engineers and developers. Using OSAT to aid group projects in educational environments has been proven to benefit both students and potential partners in developing communities (Pearce, “Appropedia as a Tool” 2009), and herein may lie the future of the AT movement both in education and practice, if educational institutes cannot or choose not to provide adequate funding for student trips to developing nations. The question of whether or not the open source format is the best way to disseminate appropriate technology initiatives has not been answered, but literature exists on the effectiveness of it as a tool to provide a service learning environment for those without alternative access to methods of gathering information.

The process of educating student engineers and developers on AT design must be centered on providing the appropriate environment for students to understand the needs of their intended community. Although it can be done either through real visits to developing nations, or through virtual experience of OSAT, the beginning barrier is for students to understand the criteria of AT in order to develop best practices.

2.3. Defining Criteria of Appropriate Technology

The design criterion that identifies appropriate technology varies. Since there is not set criteria, it becomes difficult to define a given technology as being “appropriate technology”, and difficult to teach students of design how to design appropriate technology. Criteria must be developed in order to define and therefore unilaterally promote the concept that has been in development for over 30 years. Most elements from AT organizations follow a similar pattern, and the most common aspects of appropriate technology can be summarized in the following proposed criteria:

1. Minimize required capital inputs
2. Emphasize labor intensive technologies
3. Utilize locally available materials
4. Affordable for individuals or small communities
5. Can be produced or manufactured in its intended community
6. Can be understood by intended community
7. Allow intended community to modify and innovate
8. Promote sustainability

Each design criterion is to be followed whenever possible, and most preferably the entire set. In order to better understand the criteria of this design process, examples may be shown that illustrate the importance of each criterion. Each criterion can be broken down in more detail to explain the nature of the AT approach versus an approach that would not be considered AT.

Table 1: Appropriate Technology Criteria

Criteria	Appropriate Technology	Non-Appropriate Technology
Minimize capital	a solution that does not require much initial capital, such as a product that can be produced in variable quantities	a solution that requires a large initial investment of outside resources or the community like a large facility
Labor intensive	a machine that requires rotary hand-crank input for power	a machine that requires a motor for power
Local materials	a product that utilizes fibers from a local, abundant plant	a product that requires man-made materials to be imported from an outside source
Affordable	a piece of farm equipment affordable for an individual or community based on annual income and cost of alternate solutions	a piece of farm equipment unaffordable for even a community based on annual income or compared to alternate solutions
Local mfg	a product capable of being manufactured with the human resources and technology provided by its intended community	a product that must be manufactured in whole or in part outside of its intended community
Local understanding	a machine that can be controlled, maintained, and repaired by its user or community	a machine that requires an outside expert to control, maintain, or repair
Local modification	a solution that can be adapted to the changing needs of the community by individuals in that community or the community itself	a solution that is specific to an individual need either regionally or in time, that cannot be modified by those in the intended community
Promote sustainability	a solution that follows sustainability criteria whenever possible	a solution that does not follow sustainability criteria or has a harmful impact on the environment or its intended community

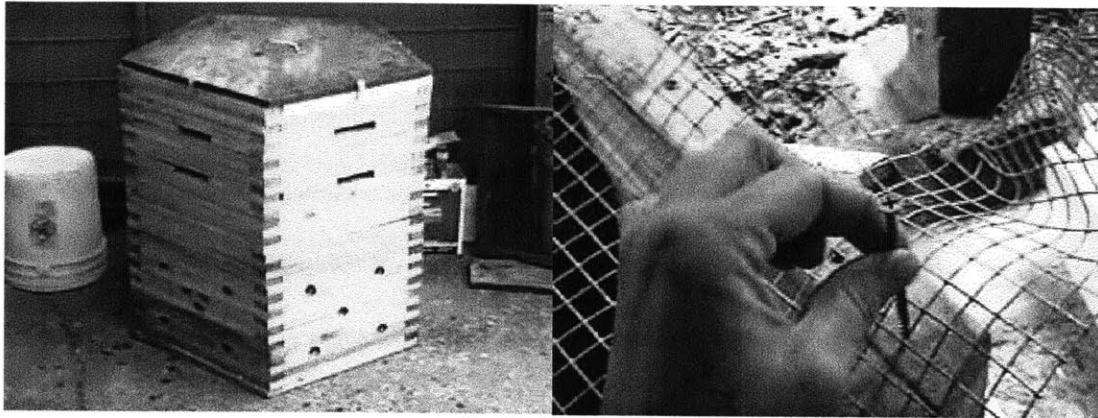


Figure 2: *An example of AT, the Vermicomposting Bin allows for easy composting for families to produce vermiculture fertilizer. The appropriate technology was designed and made by students at the Humbolt State University Campus Center for Appropriate Technology and instructions for manufacturing are distributed through the open source database Appropedia.org. (Appropedia.org 2011)*

Despite this strict set of criteria, designing appropriate technology does not solely depend on producing the most comparable product to a solution used in a developed community while following the defined guidelines (Lichtfouse 2009). For example, the One-Laptop-Per-Child program, does not locally manufacture the products, but is thought of to be a successful example of appropriate technology. Rather, AT is an approach that must be thought of as a holistic attitude towards developing the best solution appropriate for a community or individual with a need to be solved. This may require looking at needs as more comprehensive than a need for a specific product or a specific solution. Engineering knowledge may not even be required to solve the specific need, and therefore looking at the problem as one that should be solved by a new innovative product is not always the best approach.

For example, Community X's development is suffering due to the high cost of a necessary process which Community X's main crop must undergo in order to ripen in the environment. The non-appropriate approach to designing for Community X's need might be to develop an alternative vehicle for applying this process to the crop, at a reduced price than the existing vehicle. This product may be innovative, labor intensive, and sustainable, but not the best AT approach to solving the community's intrinsic needs. Community X needs to produce this matured crop in order to compete successfully in the market against other communities producing the same crop. An alternative solution to this problem may be for Community X to examine its resources and for the designer to introduce a new crop which better fits the environment and allows the community to be a competitive player in their market.

In order to make the best decisions according to the needs of the communities which appropriate technology intends to serve; in order to understand how to use local materials, how much labor is available, how producers and vendors buy products, how local users choose products—it is best to visit the community itself to gain primary knowledge of the community's needs, expectations, and capabilities. However, in higher education, with lack of funding, these trips are not always possible, and students may provide solutions that do not best fit the AT criteria and do not best solve the community's needs—and therefore, may not be as successful.

3. Appropriate Technology & Education

3.1. Social Context & Service Learning in the Educational Setting

Since the beginning of the AT movement in the mid 1970's, there have been several attempts at incorporating the AT design process into educational environments (Morris 2009). In programs that reflect the need for educating young engineers about the validity and benefits of using AT criteria when designing for developing nations, similar criteria are used to motivate students to apply engineering skills to promote solutions for small communities.

The necessity of the AT design process education is not solely promoted by the solutions it develops. Giving societal context to the class setting has allowed students to become more aware of their purposes and effects. Nihad Dukhan, Associate Professor of Mechanical Engineering at University of Detroit Mercy did a study of a service project for engineering students aimed at increasing the societal context of their education. Dukhan found that the engineering service project resulted in a positive and profound experience for the graduating students, and contributed to their understanding of the context in which they design (Dukhan 2007). The study shows the underlying benefits of providing students with real life experiences in the communities they are intending to design for. Numerous more surveys and studies show university students are benefited by service learning, a teaching method that combines academics and community service (Bringle 1996) (Pearce, "Appropedia as a Tool" 2009). With the substantial decreased in sustainable development investment (Morris 2009), the increase in incorporating this method becomes more important. In addition to student benefit, community

partners receive nonprofit aid through small-scale class projects and potential future partnerships with emerging engineering and development leaders.

Many engineering institutions agree on the necessity of giving their students social context for their design and engineering work (Dukhan 2007). Within the scope of AT, the communities that give context to a particular design or solution are not familiar to the average student. At MIT, most of the students enrolled in classes or organizations focused on developing AT solutions are from the developed world. 92% of MIT's incoming freshman class in 2010 consisted of US citizens and permanent residents. Only 8% of the class was international, and many of those students were from other developed nations (MIT, "Incoming Freshmen" 2010). The communities therefore, are remote and unknown to the engineering students, and giving context to their work requires funding for class or group visits.

In order to promote this educational experience, the Institute founded the D-Lab program, a series of courses teaching students how to design AT solutions. The courses offer students the chance to travel to communities in developing nations to assess critical needs and spend a substantial part of their semester designing solutions for problems they witnessed firsthand. The program has expanded over the years and developed into evidence of an exemplary method of teaching students how to design appropriate technology while creating many successful AT products.

3.2. The International Development Initiative at MIT

3.2.1. IDI Program & Development

The international Development Initiative (IDI), a young program with 5 years at MIT, has continuously evolved since its start as an overhead organization to marry the Public Service Center (PSC) and the D-Lab course programs started by Amy Smith. The main objective of the IDI is to promote, fundraise, and organize student and faculty projects concerning international development, including design and implementation of AT (MIT IDI, “Guide” 2010). The IDI directly and indirectly funds individual students and student organizations as well, allowing many undergraduate and graduate students to travel for international development data collection and analysis.

The IDI funds students and projects by directly contacting organizations with grants for development work, such as the Carnegie Endowment for International Peace or the Muhammad Yunus Innovation Challenge to Alleviate Poverty, and applies for various grants and funding on behalf of the projects at MIT (MIT IDI, “Guide” 2010). Most of the funding through the IDI is received by these outside organizations, rather than the Institute itself. With the gaining notoriety of the D-Lab program, organizations have begun to contact the IDI as well.

Once received, the funding is distributed to projects and people in several ways. The main vehicles for beginning an AT project at MIT include:

1. *Student run projects*: The bulk of AT projects started at MIT grow out of student proposals. Graduates of classes that promote development, including D-Lab and the Mechanical Engineering department's "Product Engineering Process" class, or possibly other interested groups on campus, propose a unique solution and solicit funding from the IDI (or subsidiary groups like the PSC). Other students or student groups solicit funding for trips abroad to assess needs in order to develop solutions or to develop relationships/partnerships with local organizations in certain communities. For example, a student solicited funding from the IDI to visit and return to a community multiple times over the course of 3 years while developing an AT wheelchair.
2. *D-Lab projects*: The D-Lab program itself consists of much of the funding of the IDI overall. The program sponsors the class visits to their intended communities over student holiday breaks such as the Institute's month long January term or spring break. The students are tasked with understanding the environment and assessing the needs and possible solutions. The students must identify design challenges in the community and return to the regular classroom environment with a driving solution to the witnessed problems. These projects grow over the course of the class and sometimes eventually transform into projects described in (1), with graduated students developing their solutions further and soliciting outside funding from the IDI, IDEAS competition, or elsewhere.
3. *Developing community partnerships*: Some IDI-funded projects grow out of cultivating a relationship with a community in a specific developing nation. This

is sometimes done by faculty members, who recruit students to join their projects as research or thesis positions. In addition several student groups consisting of both graduate and undergraduate students hold partnerships with specific communities. The Global Poverty Initiative (GPI), a student run group, works with La Vacita in Mexico. Another campus group, Engineers Without Borders (EWB) works closely with a community clinic in Uganda and sends students abroad to work on projects, including a process for creating charcoal from agrimass. The relationships further the projects and provide good support for future funding. Most of these partnerships develop from student or faculty interest, but a few initial requests come from developing communities themselves. Due to the increased publicity of the IDI and the development efforts of D-Lab, specific communities have begun to reach out to the organization with specific needs.

The overall goal of the IDI and its programs can be expressed in two ways: making a difference in the world with applied engineering and subscribing to the appropriate technology perspective in design and implementation, and creating global leaders with skills to continue development work outside of MIT's undergraduate curriculum.

In addition to offering funding for AT projects, the IDI holds large events to raise interest in the international development work happening at the Institute, including the annual International Development Fair (IDF) to showcase various projects and events sponsored by the Harvard-MIT International Development Conference (IDC) (MIT IDI, "Guide" 2010).

3.2.2. D-Lab

As part of the International Development Initiative at MIT, D-Lab offers students an opportunity to take classes or participate in projects developing appropriate technologies and solutions for low-income households and communities. These initiatives focus on designing appropriate technologies and giving students and educational experience that will allow them to better understand the problems and appropriate solutions in the developing world. Students at MIT can participate in D-Lab classes covering a broad range of topics including development, design, energy, health, prosthetics, mobility, dissemination, and more. These classes focus on “using technology to address poverty, building the local creative capacity, promoting local innovation, valuing indigenous knowledge, fostering participatory development and co-creation, and building sustainable organizations and partnerships” (D-Lab, “About D-Lab” 2011).

Focus on valuing indigenous knowledge and innovation falls under the criteria for AT, and many of the projects designed and implemented through the IDI’s D-Lab program. Since 2008, the D-Lab courses have produced over 119 development projects that span the offerings of 8 distinct classes including Development, Dissemination, Design, Mobility, Health, Development Ventures, Developing World Prosthetics, and the newest, Energy. These projects range from NZ Capital, a micro-banking services venture in Zimbabwe, to BabyTracker, a labor contraction monitor intended for Nicaraguan hospitals (D-Lab, “Projects” 2011). Additionally, all of these projects are created with the AT criteria in consideration.

3.2.3. IDEAS Competition

The IDEAS (Innovation, Development, Enterprise, Action, and Service) Competition held each year at MIT in order to promote teams of students and community members to innovate and collaborate on service projects. Teams can be awarded up to \$10K each year, and over the past 10 years, the IDEAS Competition, a part of the Public Service Center (PSC) has awarded over \$250k to more than 60 distinct teams. The winning projects from this competition are awarded funding sponsored from corporate and industry sponsors, MIT alumni, MIT affiliated companies and programs, or a combination of various sponsorships. Past winners include projects that began in engineering courses, such as Komera, a project to create job opportunities manufacturing sanitary pads out of local materials in Rwanda, which began as a project in the Product Engineering Process class in Mechanical Engineering undergraduate curriculum.

3.2.4. MIT Global Challenge

Built on the success of the IDEAS competition, MIT created the Global Challenge program to celebrate the Institute's 150th class. The Global Challenge promoted students to define needs in communities around the world, generate solutions to those needs, formulate proposals and prototypes in teams, and compete for implementation of their projects over the course of one year (PSC, "IDEAS" 2011).

Over 86 teams of students entered the 2011 IDEAS Competition and the Global Challenge in conjunction, in the areas of: Health and Medical, Education and Training, Energy and Environment, Water and Sanitation, Finance and Entrepreneurship, Agriculture and Processing, Mobile Devices and Communications, Housing and Transportation, and Emergency and Disaster Relief. Projects ranged from individual products like inexpensive grain mills made of local materials to close-looped system architectures producing healthy crops in areas of limited arable land such as the Niger Delta (PSC, “Global Challenge” 2011). The proposed solutions are voted on by the community and judged at the end of a year in order to qualify to win the funding. The competition not only allowed for 86 unique solutions to be proposed, but for a select few solutions to take effect due to community and industry sponsors. In addition, the projects are posted on the Global Challenge website, viewable to MIT community members for discussion and collaboration, providing more outlets for community participation.

4. Open Source Appropriate Technology in Education

OSAT is a movement to openly publish designs and specifications of AT solutions. OS formats for software show the usefulness of such a technology sharing program. The significance of OSAT has been argued to improve not only the quality of AT, but the rate at which new ventures are being undergone to increase the use of AT in aiding developing nations. Not only does the OSAT provide relevant data for current researchers and engineers, but can also be used as a primary educational tool to assist the efforts of educating future engineers and developers with the AT approach (Pearce, “Appropedia as a Tool” 2009).

Two major OSAT databases exist on the internet- Appropedia and Ekopedia, English and French collections of AT designs and solutions. The databases follow the model of Wikipedia- where users can upload designs and examples of AT for others to use or modify according to their own needs. Although several main challenges to the OSAT approach exist-- language barriers, access to internet, funding, and infrastructure, with the popularity and demand for open source databases similar to Wikipedia, OSAT could play a major role in the continued efforts of revitalizing the AT movement in the 21st century (Pearce, "Overcoming Technical Constraints" 2009).

The importance of OSAT can also be related by its significance in aiding the AT movement in education. A study was done in evaluating the usefulness of using OSAT in the form of the online database, Appropedia, as an educational tool in a physics class. Students at the Clarion University in Pennsylvania enrolled in a semester long project class that tasked them with using Appropedia to develop and share AT based on academic work. The class was taught as a virtual classroom, with the projects being based solely on the OSAT database. The students developed campaigns to promote the use of sustainability in their own communities, and had successful ventures to retrofit LEDs in street lights. Some of the students even continued projects after the conclusion of the physics class, and all of the students found their experience positive in helping them learn the academic material as well as contribute to the sustainability of their communities (Pearce, "Teaching Physics" 2007).

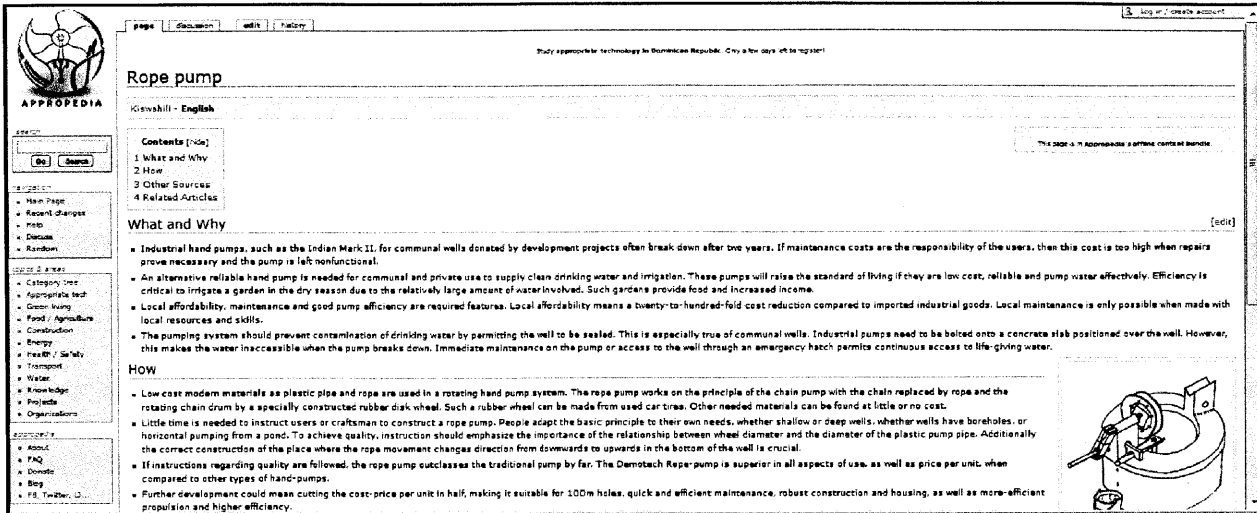


Figure 3: An example page of Appropedia.org. This page describes the purpose, and technological principles of a industrial hand pump for communal wells. The page also links to the project home and related projects. (Appropedia.org 2011)

4.1.1. Recommendations for Integration of OSAT into AT Education

Although integration of OSAT into mainstream higher education has been considered in the case of the preliminary physics classroom experience at Clarion University in Pennsylvania, a significant step can be taken to integrate OSAT into an educational experience focused solely on developing appropriate technology at universities. Although students of MIT's D-Lab program often use online sources and Wikipedia to aid their projects, there is currently no structured course for integrating OSAT as a substitute or compliment to real trips. The following section outlines a possible method of integration.

4.1.1.1. Foundation Development

The first procedure for implementing OSAT resources into this setting must be to educate students with the OSAT software and databases themselves. Additionally, students should learn the criteria for designing appropriate technology products, as outlined in Chapter 3. This can be done concurrently through exercises which task the students to develop sample pages on an OS database to learn the features of using the OSAT software. These sample pages could be introductory pages of the students' interests and biographies, as done in the previous OSAT study, or perhaps analytical breakdowns of current AT products and solutions, through which the students may better understand the nature and goals of the design criteria. Through this exercise, the students should learn to identify traits of products as being appropriate for their intended community, and to distinguish advantages and disadvantages of alternative solutions to community needs. Overall, an introductory understanding of both AT and OSAT must be completed by the students before continuing on to learn about their intended community and its needs.

4.1.1.2. Understanding Community

The next procedure would include a comprehensive education concerning the intended community. This step would be require critical usage of OSAT to develop partnerships with communities around the world, other university students from such communities, or other university students or AT developers familiar with the needs of the communities. This step would include exercises to develop the students' understanding of cultural, language, social, and

political barriers that is necessary in order to develop the appropriate solution. For universities and institutions where funding is not available to send students abroad, this is where OSAT could be used as a virtual educational tool in order to inform and educate the students on the realities and needs of their community partners.

Through the use of OSAT, both in learning about the community for which the students intend to aid, and about the fundamentals of the AT approach, students can also develop an understanding for the problems which afflict their community partners. These problems could be witnessed by the students through contact over OSAT with community members or other developers/students who have acquired the resources to travel. The students should document all needs witnessed through their communication. OSAT provides a virtual educational experience that allows students to understand and eventually design for the community without the expensive class trips which prevent many universities from developing AT programs.

4.1.1.3. Solution Development

The next step in this course would be the development of solutions to the needs documented through the communication. The students should spend a substantial amount of time brainstorming and ideating solutions to the needs witnessed. From these individual brainstorming exercises, the students should write “stubs” (uncompleted pages used in OS databases like Wikipedia, Appropedia, Ekopedia) outlining their design, manufacturing, and implementation ideas, along with sketches or models of a few critical ideas that take into account the AT criteria.

From this process, students can team up in groups to focus on a few critical ideas, which should be modeled and tested for feasibility. These select project models should be developed not only by the students, but concurrently by their community partners. Students should upload designs of their models or mock-ups to their OSAT pages, with instructions for community partners to build and iterate their own versions out of available materials and known processes. Through this prototyping process, the students should remain in constant communication with their partners to discuss improvements, troubleshoot problems, collect human factors data, and develop their solutions further. Out of these critical ideas, each team should select their final project and develop a campaign for future plans, goals, and strategies concerning the product or solution development, design, manufacturing, and distribution.

4.2. Building OSAT Databases

Once these ideas have transformed into iterated prototypes, the students can complete their OSAT pages and if they choose to continue in subsequent years, advertise for funding from organizations, companies, and nonprofits to aid the development of their projects and perhaps allow them the financial resources to travel to the community and further iterate. These more developed projects can utilize the funding available to the institute of higher education, after having gone through the process of proving feasibility and likelihood of implementation.

For universities and programs that do not have the funding to send students abroad, these projects can and should be updated continuously on the OSAT database for use by other educators, students, and AT developers, increasing the public knowledge of AT technology and

assisting others with funding in developing further iterations and spreading the technologies to more communities. This allows the OSAT and AT community to grow in understanding the needs and working with existing solutions developed by the students.

5. Conclusions

Although developers agree that the appropriate technology movement, which promoted a humane approach to aiding communities in development, has ended, with consistent evidence of the enthusiasm and motivation behind student service learning and the introduction of new virtual methods of developing relationships and partnerships with communities abroad, the AT movement has a chance of revival. With the MIT program consisting of D-Lab, the IDEAS Competition, and the new Global Challenge, evidence exists of successful ventures in educating university students to promote and utilize the distinct AT criteria. This program, however, is only made possible by the persistent and constant funding raising done on behalf of the students and faculty by dedicated program leaders in MIT's International Development Institute.

Without such a thriving program, the many successful products that come from the D-lab courses and PSC competitions would not exist. Institutes and universities without such funding can and should utilize another option—the open source databases of appropriate technology solutions that exist through the internet. Courses designed around the use of OSAT as means of educating students on appropriate technology, developing deep understandings of the needs and resources of remote communities, and distributing information to other students and developers would lead to substantial contribution by students whose access to travel funding is limited.

Open source not only allows students to learn, but provides meaningful ways through which they can contribute—and could reinvigorate the movement whose ideals of sustainability and community self-reliance still exist, and thrive, today.

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