TECHNOLOGY & SUSTAINABLE DEVELOPMENT

How online tools can educate

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Introduction

This paper will cover and outline some recent technologies and applications that contribute to the education for sustainability (ESD) movement, along with examples of their uses that can be used as models and case studies for future projects. In effect, technology is and will be a major player in the ESD process through information dissemination seen via distance education technologies, the Internet and Web 2.0 social applications. This is not to say that technology is the cure-all for world problems. It is not. Instead it is a tool that enhances sustainability education and brings about greater access to the everyday person to partake in ESD initiatives and goals.

ESD themes are missing in education

Officially, as defined by the Brundtland Report sustainable development is that which "... seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future." (Brundtland, 1989, Chapter 1, para 49). In 1992 at the Earth Summit in Rio de Janeiro the Commission on Sustainable Development was created to monitor the progress of the summit agreements. Among these agreements was Agenda 21, which included the following main domains concerning sustainable development, (a) social and economic dimensions, (b) conservation and management of resources for development, (c)
strengthening the role of major groups, (d) means of implementation. That final section, means of implementation, includes promoting education and public awareness through teaching and training (Earth Summit+5, 1997; United Nations, 1992). These themes from the Earth Summit lead to the creation of the Earth Charter Initiative, which lists the main values and principles needed for a sustainable future, and among which is included the integration of sustainable principles and values into educational systems.

At the 2009 World Conference on Education for Sustainable Development, ESD was outlined as being based on values “of justice, equity, tolerance, sufficiency and responsibility” meant to promote not only gender equality and poverty reduction, but also human well being through healthy production and consumption patterns that protect natural resources (UNESCO, 2009a-b). In effect, ESD supports greater environmentally responsible behavior, economic viability with a triple bottom line, and a more equitable peaceful society where cultural and natural heritage are preserved in a manner that sustains viable living for future generations as well (Brundtland, 1989; Earth Charter Initiative, 1992, 2010; UNESCO).

As noted by some, these themes are not sufficiently addressed in many of today’s education programs, including primary, secondary and tertiary levels. ESD calls for a change in the fundamental purpose of education. It encourages a change in the philosophical foundations of educational programs so that these key themes important to sustainable development are better addressed. Successful ESD requires transdisciplinary learning that accounts for the holistic interconnected nature of these themes (UNESCO, 2009a-b; Wagner, Day, James, Kozma, Miller, & Unwin, 2005). This process will require a change in the approach to, and design of, educational programs.

Current natural and cultural heritage preservation movements come under several titles: Education for Sustainability (EfS), Education for Environment and Sustainability (EfES), Education for Sustainable Development (ESD), and Environmental Education (EE). Regardless of the acronym used each movement has at least one similar objective in common: creating sustained use of resources on Earth through natural and cultural preservation such that future generations of all species may live well too. It is time for these leaders to work together for a new holistic, combined vision and future on the pressing concerns facing humanity, which are too great for any one of these movements alone to solve. Collaboration and innovation between ESD and EE professionals would include national and local leaders, private sector representatives, scientists and technical experts, public information specialist, and educators in related fields, among others all to address sustainability concerns together. As a team these professionals from ESD and EE can best address sustainability needs productively.

One of the means by which these stakeholders may work on sustainability education together is through the use of information and communication technologies (ICT), and ICT plays an important role in helping facilitate the ESD goals due to its expanding tools and access (UNESCO, 2009a-e; Wagner, et al., 2005). The world is now interconnected through technology more than ever and it allows for a strong new propelling force in social change and education based around ESD because it allows for collaborative democratic and socially supported team projects.

**Technologies used in ESD**

Technology and new software movements have created an environment full of online learning opportunities, both formal and non-formal. Distance education (DE) technologies can
include (but not necessarily be limited to): correspondence study, video, audio, Internet, or multimedia. These can be transmitted to the learner via mail, Internet, telephone, TV, satellite, microwave, radio, fiber-optics, mobile, and other connections. The Internet is commonly used for many of these technologies (Simonson, Smaldino, Albright & Zvacek, 2009; Smaldino, Lowther, & Russell, 2008). The Internet is commonly used for many of these technologies. The caveat is that in developing nations without even telephone access the Internet is of much less use than other technologies such as mobile, satellite, TV and radio (Simonson et al.; Smaldino et al.).

The technology types just discussed have made communication and connection available in a wide area of the world. Now people from previously isolated regions may contribute, learn or disseminate information more easily. This is both a benefit and drawback to social change as a whole. Information dissemination is necessary for social change to occur. Access to that information is the challenge that many programs face. And finding credible information online is now a potential barrier.

**Technology Applications for ESD**

As previously outlined there are many different technologies and software applications that can be used. The caveat in ESD is that sustainability education must reach a wide audience, some of which reside in developing nations where communication means common to developed nations are not possible. What follows is an exploration of how different technologies are and could be used.

**Non-Internet Technologies Usable in Developing Nations**

Across the world in developing nations the power of knowledge is needed, yet most live without access to even basic education. Without a basic education for all (EFA) global citizens the goals of sustainability will be difficult to achieve. Without access to learning about sustainability principles one cannot implement them. Improving access to education is necessary if the goals of sustainability are to be met.

Among the Millennium Development Goals (MDG) instituted by the United Nations is the objective of universal access to primary education for all global citizens by 2015. The 2010 MDG report states that enrolment in primary education has risen to 89% in developing nations, but that this objective is unlikely to meet its target of 100% by 2015 (United Nations, 2005; 2010). Some barriers to meeting this goal have been an insufficient teacher base, lack of classrooms, and lack of curriculum resources (United Nations). Some of these barriers could be alleviated with some of the following technologies meant to improve teacher-training opportunities and access to education in rural and developing areas otherwise missing the needed infrastructure and resources for addressing educational gaps (United Nations; Wagner, et al., 2005). The following information and communication technologies (ICT) contribute to improving access to educational opportunities in rural, underprivileged and developing nations.
Mobile education (M-learning). M-learning is on the rise in developing and rural communities where Internet access is intermittent, slow, or non-existent. Mobile phones can even come with solar chargers for areas to which electricity does not extend. M-learning has a real advantage for the underprivileged in developing nations, as well as rural or poor folk in developed ones, and finally also for the physically challenged that cannot easily leave their homes. It lends itself well to the ESD goals of raising global equity by allowing for increased access to educational opportunities and world news for a greater number of people (Ally, 2009; Motlik, 2008; Traxler, n.d.; Trucano, 2009). The drawbacks to m-learning are the small screen size and the need for specialized files that can be downloaded and viewed on the phone. The phones can be hard to read in daylight, and hard on the eyes due to the small text and screen size. Specialized programs often need to be created as well, and typing in a mobile phone is not as easy as on a netbook, laptop, or computer. Therefore, submitting work can be more difficult. The cost of a phone can be less than a laptop and more portable, with a monthly cost thereafter, but then so would broadband access for a computer.

Micheal Trucano, an ICT specialist at The World Bank, points out that research on using mobile phones in education has been going on for some time and that we may now be reaching a tipping point for its quick adoption by more users than ever before (Trucano, 2009; Rogers, 2003). An example of this use is the new M-learning program being rolled out in India meant to reach women, the physically challenged, and those in rural areas that otherwise cannot attend school. This education program will be run by Tata Teleservices in conjunction with SNDT Women's University, Atom Tech, and Indian PCO Teleservices, and is meant to bring greater access to education for those who previously were prohibited from higher learning due to various physical and geographical constraints.

Another example of a successful m-learning program is between Tufts University in the United States and Christian Medical College in India. They created a collaborative e-learning program that supported m-learning in remote areas for clinical training. Their m-learning module involves three key elements, (a) underlying management system for data, (b) mobile accessibility, (c) mobile applications that meet student needs. Their model can be implemented in other developing nations where access to the Internet is limited (Vyas, Albright, Walker, Zachariah, & Lee, 2010). In Nigeria mobile learning is used to help improve literacy rates among nomadic peoples (Aderinoy, Ojokheta & Olojede, 2007). In Africa, the rate of mobile phone subscriptions had reached 28% by 2009 (infoDev, 2010). In many areas where there is no electricity people still have phones. Several new programs to introduce literacy education programs via mobile are also being implemented by the Shuttleworth Foundation by fellow Steve Vosloo (infoDev; Shuttleworth, n.d.).

There are evaluation plans and frameworks for analyzing mobile technology for distance education. For example, the Framework for the Rational Analysis of Mobile Education (Frame) Model. This framework looks at human learning and social interaction on mobile technologies and can be useful in implementing a new program (Koole, 2006). Through using the evaluation and project plans of other m-learning programs one can attempt to instigate more successful outcomes in new projects. One such program that easily allows creating educational programs for mobile phones is Mobi21 (www.mobi21.com).
Some suggested ideas for using m-Education include:

- Training modules for companies using mobile educational software. Employees may review them while commuting to work.
- Exam reviews that students can cover on their way to school.
- Case studies for professionals.
- Teacher training modules for teacher education in rural and remote areas where cell-phone coverage is the only available technology.
- Health and safety information for farmers in rural areas.
- Many phones can now scan item bars in stores, and retailers could include eco-information about the products they sell (Mobile barcode scanning).

**eReaders.** As an alternative solution to some of the mobile device learning drawbacks, such as a small screen, larger eReader devices can be used. Devices such as Kindle or the iPad allow for easier reading of online media and eBooks. The Kindle has free, 3G wireless coverage in over 100 countries using their Whispernet service. The benefits of an eReader are the larger screen, including the electronic-ink display on several which can be viewed and used in high sunlight conditions and that do not tire the eyes after hours or reading. Other benefits are the storage of 100s of books on one device, ability to take notes and make highlights, and access to 3G downloads in rural areas around the world (depending on coverage). The drawbacks are the cost of the eReaders that can be inhibitive, lack of access to downloads in many parts of the world, increased difficulty of taking notes or searching for specific topics in an eBook file, and as yet low quality pdf viewing.

Some suggested ideas for using eReaders:

- Sustainable business and practices guides and manuals that can be downloaded and used by employees.
- Academic and professional news and media, including reading professional or company-related blogs.
- Textbooks as eBooks, which are often cheaper and would be more accessible to rural and developing areas of the world where access to regular textbooks may be difficult.

**One laptop per child (OLPC).** The OLPC program is working to provide educational opportunities and Internet-data access to children in developing nations. The XO laptops are rugged, portable, lightweight, without moving components such as a hard drive, and powered with a wind-up crank so that in electricity-poor areas children may still use them. The price of the computer is reduced by using a simplified open source operating system, and it is made extremely durable with automatic wireless Internet connection. Finally, it has a screen that can be viewed even in sunlit conditions. In order to get any needed Internet connections to some rural areas there are free satellite connections through SES Global once the connection terminal can be funded. The OLPC program has the potential of allowing previously under-represented groups the chance to access the Internet and make new social connections with the rest of their country, in their language. (OLPC, 2009; Iiyoshi & Kumar, 2008; Moore, 2007).
Opponents and critics of the OLPC program, though, point out several reasons why they feel the program is not feasible. In an educational technology debate hosted by InfoDEV, several technology experts analyzed the pros and cons of the OLPC program. Critics included Wayan Vota, Mark Warschauer, and Leland Smith. Criticisms included factors such as the cost for computers instead of paying for more teacher training and classrooms, or the availability of other cheaper technologies instead, or the lack of needed infrastructure and teacher support (InfoDEV, 2009). Many felt that the money was better spent on improving teacher education and quality curriculum rather than giving each child a laptop. There are concerns that this is a waste of time and resources that would instead better benefit children in developing nations through other programs.

**Satellite and television.** Television and satellite offer both one-way and two-way learning opportunities. Satellites carry most networked television transmissions and also offer up Internet connection and can bring connection to even very remote settings. The downside to them is that they need a power source, even if locally generated. Television can also be delivered via broadcast and microwave transmissions, though drawbacks are the need for powered receiving towers and the latter only travels in a straight line-of-sight (Simonson, et. al, 2009; Smaldino, et. al., 2008). There are also initial installation and satellite costs, as well as the receiving parties must have the power source and TV available.

Some examples of successful programs:

- Iowa State University, USA offered a sustainability agriculture course nationally via satellite (Salvador, Miller, & Schmidt, 1993).
- The satellite education program with Rural health Education Foundation in Australia. Needed health education is broadcast via satellite to rural and isolated villages and indigenous groups in Australia, and other countries in Asia are now collaborating to offer similar tele-medicine programs (Misra, 2010; RHEF, n.d.).

**Interactive radio instruction (IRI).** Finally, radio transmission has been used for distance education programs in developing nations. The World Bank, UNESCO, and other non-profit groups are utilizing IRI as a means of increasing access to education to under-represented groups, such as out-of-school adults, women, children, handicapped and ruraly isolated populations. The World Bank (2005) explains, "Studies of the IRI experience in more than two dozen countries during the past 25 years have shown that the use of IRI has led to significant and consistent improvements in school achievement and has helped overcome equity gaps between urban and rural children and between boys and girls" (p. ix). The benefits to IRI are its low cost technology and broad coverage (The World Bank, 2005). In South Asian countries one-way radio learning has been used to supplement distance-learning programs, though the drawback is the lack of interactivity between the student and teacher (PricewaterhouseCoopers, 2010).
Some examples of use:

- Teacher education in rural areas with limited technology or Internet access.
- Health and safety information concerning pesticide use for rural farmers.
- Lectures and learning modules for students in rural areas.

Internet Technologies Usable for ESD

The Internet has led to an increase in information dispersal and community building across the globe. This has led to more access to world news, information, and social gathering from a wider audience. It also allows for more teaching and learning in a variety of contexts and places, and from multicultural perspectives. Through open source software and other similar initiatives there are a variety of free and cheap software for use. Information dissemination via non-traditional routes is a growing phenomenon made particularly successful due to the Internet, new Web 2.0 social applications, and open source technologies.

This kind of non-formal and socially constructed education of the masses is democratic in its truest sense since it is the people who decide what is important, and what news to spread. It is the people who teach and inform each other. It is an expanded form of student-centered non-formal life-long learning. This is both good and bad depending on the use or misuse of technology access to online information. Experts, academics, professionals, scientists and other knowledgeable people have a duty to join this movement and make sure that credible and accessible information is added to the mix. When a blog is free to read, but a peer-reviewed academic research article hard to find and expensive to download, it becomes clear to which information people choose to pay attention. Opening up access to all forms of credible data and information is important to Education For All (EFA) goals, for all age levels. Following are a few of the tools that ESD educators could use to disseminate important information.

**Microblogging** The latest craze in Web 2.0 is microblogging on Twitter and other such online applications. It is free, easy to understand and use, and it makes it easy to disseminate information. Experts in the field can use it to quickly share important subjects and links, including about environmental and cultural preservation and sustainability education. The benefit to microblogging is the network array in which information can quickly spread. The drawback is that the posts can only be 140 characters or less (Solomon & Schrum, 2007; Richardson, 2009; Bell, 2009).

Some examples of use:

- Capitalizing on microblogging Ideal Bite ([www.idealbite.org](http://www.idealbite.org)) offers a small-sized simple bite of sustainability information each day. From quick facts about grain-fed meat to environmental protection, each one is meant to be a simple tactic a person can easily introduce into daily routines.
- Business, program, or project announcements.
- Class updates, information and important web resource links.
Podcasting and video. Podcasting (audio) and video (visual and audio) are multimedia educational tools that can be used formally or informally to educate others about sustainability principles and agendas. They can be informal types of blogging or formal educational training with multimedia inclusions. The benefit is that they are audio and/or visual and are easily viewable and downloadable from the Internet. The drawback is that one needs specialized equipment and software to produce them, though that tool can be as simple as one’s video-equipped cell phone (Solomon & Schrum, 2007; Richardson, 2009; Bell, 2009). Such media (audio and visual podcasts or video) is a simple way to disperse sustainability information, including teacher training and student lectures.

Some examples of use:

• The sustainability podcast series at Indiana University, which through audio media attempts to educate the public on some key issues (http://podcast.iu.edu/Portal/PodcastPage.aspx).

• The popular video about sustainability principles called The Story of Stuff (www.storyofstuff.com), by Anne Leonard.

• Video lectures or training modules for students or employees that are placed at YouTube, which can also be accessed via a mobile phone (smartphone).

• Lectures, company information, or training modules as a podcast that can be placed at podcast sites such as Podcast Alley and then accessed via a music player, RSS feed, or mobile phone.

Blogging. Web logs (blogs) have been popular for several years. There are blogs on any topic, from travel stories and photos to reporting on educational technology in developing nations such as at The World Bank and InfoDEV blogs. They are interactive forms of communication by anyone with a computer connection, and anyone may comment on them in return. Anyone wanting to help educate the Internet population about sustainability principles may use a blog as the delivery format. There are public websites such as Blogger where one may easily set up and create a blog for free. If one wants to host their own blog at their own server space then they can download and use free open source content management systems such as Joomla and WordPress. The benefits of blogging are that it is easy to learn how to do it. The drawback is that one must commit to regular quality entries on their blog if they hope to gather a following (Solomon & Schrum, 2007; Richardson, 2009; Bell, 2009).

Some examples of use include:

• A company can have some of their experts post to a company blog on a given topic, which will draw interest and followers and give the company credibility within the field, such as InfoDEV, the World Bank blog (www.infodev.org)

• Teachers can have students write blogs on their major so improve writing skills and sharing of ideas and information among the students through commenting.

Wikis. The new-age encyclopedia is an online community-driven knowledge source. Wikipedia has spawned a new generation of websites meant as collaboratively built centers of information. These can be private groups that limit who can contribute and edit the articles, or fully
generated by the public. The benefits to Wikis are the massive global collaboration, contributions and discussion that can take place at the same time. The drawbacks can be the quality and credibility of publicly generated and edited content and monitoring for SPAM related issues.

Some examples of use:
- Wikis can be easily created for classroom projects or informal education on the Internet.
- Wales' new Green Wiki, a collaborative community building and sharing green-ideas (www.green.wikia.com).
- Companies can use an internal Wiki as a collection of procedures, project information and updates.

Social Networks. Other great tools in the endeavor to educate the public about sustainability principles are the new social networks. They allow an immediate access to a wide audience from around the world by which to disseminate information. Just a few examples are LinkedIn, Facebook, NING, and MySpace. Each allows members to create and manage groups on any topic. The benefits are instant access to multinationals on all topics and the ease of use of the website. The drawbacks are the limits on group numbers and limit on control over the group's pages.

Some examples of use include the following:
- There are many environmentally related groups in NING and Facebook, and LinkedIn, such as the Green Group on LinkedIn.
- Schools, businesses, and organizations can start online social networking groups as a way to increase awareness, spread announcements, and diffuse important information.

Conclusions

The outlined technologies can help promote ESD in different ways. In many cases, technologies for ESD must be implemented in developing nations where objectives are to increase education for all, but limited learning resources, classrooms, and trained teachers are barriers. In these situations where Internet is also limited or non-existent, other ICTs besides computer and Internet-based technologies can be used to meet ESD objectives. Technologies such as mobile phones, satellite, radio, and television lend themselves well to these situations, including offering more teacher-training and educational access to rural areas previously lacking in enough qualified instructors (Wagner, et al., 2005).

The examples listed with each technology can be used as a model to implement similar programs or actions elsewhere. Many of the technologies can also be used in collaboration with each other on ESD projects wanting to implement a variety of tools and approaches. Finally, for new projects and programs implementing ICT for sustainability and development education, an evaluation program should be set up. Wagner, et al. (2005) developed a full method for the monitoring and evaluation of ICT education impacts and capacity building.

Access to education is only the first step in ESD. As the old proverb says, one can lead a horse to water, but they cannot make them drink. Even if people know about the issues they must do something...
about them or it is the same as if they had not known about them in the first place. In effect, future research and work may center around these key questions, (a) how do we offer more reliable information through these technologies to underrepresented populations, (b) how do we get people to see and read it, (c) how do we get people to implement and use it? These technology options help to increase the chance that more people may be able to access the information necessary to make informed choices and important life-style changes as related to sustainability objectives, but future directions in the use of technology in sustainability education will have to center not only on dispersing the knowledge, and not only on the kinds of technology available. Future directions will also need to center on encouraging action upon knowledge, with evaluation plans that analyze not only implementation but also result-oriented outcomes.

**Sources**

http://www.amazon.com/gp/help/customer/display.html?ie=UTF8&nodeId=200505460


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