Uses of Gigapan Technology In Formal And Informal Environmental Education

Jerry Schoen
Water Resources Research Center
UMass Amherst
jschoen@tei.umass.edu

R. D. Stevenson
Department of Biology
UMass Boston
robert.stevenson@umb.edu

ABSTRACT

Gigapan technologies present new interactive opportunities for people to learn and share information about their local environments. They can be used to look across spatial scales, enrich multimedia journals, and augment digital collections. Herein we describe initial efforts and experiences in sharing information about plants, geology and landscapes in both formal and informal education settings. Our diverse examples suggest ways that current Gigapan technologies can be improved and linked to other technologies and educational programs.

Keywords

Plant Identification, Phenology, Plant Reproduction, Riparian Conservation

Botany, Geology, Conservation Biology, Environmental History, Citizen Science

INTRODUCTION

The broad trend of urbanization over the last century and the reliance in our society on technology for entertainment isolates more and more people from their environment[1]. Gigapan technologies, in contrast, offer a variety of ways for people to discover, explore, and collect data about their environments. The University of Massachusetts is experimenting with using these technologies in both formal and informal science environmental education settings. This paper discusses four examples:

- "Seeing the Forest and the Trees" (SeeTrees), is a National Science Foundation funded project that uses Gigapan and other information technology (IT) to enhance undergraduate education in courses at UMass.
- "Buds, Bugs and Brookies" (BBB), is a project proposed to NOAA's Environmental Literacy Grants program (Informal Education), that develops visualizations for the community using Gigipan IT, and is based on phenology data gathered by anglers, on coldwater streams and their riparian zones.
- Connecticut River Tri-State Targeted Watershed Initiative (TWI) is an EPA sponsored effort that uses Gigapan images as a public outreach tool for describing the geology of the Connecticut River Valley.
- Stories Of Place (SOP) is a UMass project, based on sharing images among communities of outdoor enthusiasts, for the Pioneer Valley of western Massachusetts.

After reviewing each project, we make some suggestions about how current and anticipated features of Gigapan Technologies can be used in environmental education.

SEEING THE FOREST AND THE TREES (SeeTrees)

The SeeTrees project is developing a framework for using new information and communication technologies to improve the field component of courses at UMass Amherst and UMass Boston. The project's goals are 1) to find better ways to teach students how to see and identify organisms and landscapes[2]; 2) to turn their observations into knowledge; and 3) to improve the ways students communicate their observations among themselves, their instructors, and with the wider world.

The second goal is usually not a significant part of course curricula, but it models what scientists do and it encourages students to becoming practicing scientists, either formally or informally. SeeTrees develops a technology-enhanced approach that a) prepares students for the field using digital images, b) facilitates identification in the field using electronic field guides (EFGs)[3] (http://efg.cs.umb.edu/), c) facilitates uploading of observations and utilizing digital media while in the field. It also encourages post-trip processing and vetting of information both individually and in groups; i.e. using database utilities, photo sharing web sites such as Picasaweb or Flickr, and social networking tools such as Facebook or Everytrail). The final product for each student is a digital science notebook for future personal use (e.g. as part of one's lifelong learning portfolio[4] or for broader public consumption as digital media for revised guides. Gigapan technology will be part of the IT tools. At the beginning of the semester, students will be shown un-annotated (e.g. no snapshots) mesoscale Gigapan images (e.g. 50-1000 foot width/depth) of different habitats (http://www.gigapan.org/gigapans/35560/, http://www.gigapan.org/gigapans/27693/), and will be asked to relate what they see in these images, with respect to plant specimens. Later in the courses, students will be given the opportunity (for extra credit) to annotate these images with information about plants found in the images. This is expected to serve more as a means of discovering and communicating students' growing understanding of plant life within various natural communities than purely as an aid to plant identification. We plan to apply JEyeTracker[5] software to Gigapans, to monitor how students see landscapes and plants by tracking mouse and zoom movements. Gigapans that successfully go through the vetting process (first via student peers, then by course professors) will be placed in public web sites, to be utilized as informal guides to local landscapes and flora. For these courses, Gigapan images will primarily have been taken prior to the courses by professors and teaching assistants; students will explore the landscape and use the snapshot tool to provide commentary. Students will be guided to a) heavily utilize the hyperlinks in both the Gigapan comment feature and the snapshot annotation tool, b) engage in more extensive discussions among themselves (e.g. by linking to specially designed Facebook pages or other electronic bulletin boards), c) review and discuss complementary photographs (e.g. by linking to Picasweb or Flickr albums of additional photos related to the Gigapan image (close-ups, images taken in different seasons, etc.) d) and/or link to additional scientific literature found on botanical or other relevant web sites.

A specific application of the Gigapan technology for understanding plant science and seed dispersal is to have students count wind-dispersed seed density at different distances from a source silver maple tree (http://www.gigapan.org/gigapans/24147/). We used Hula hoops to define a standard area and we will have 3-5 students in the class count the seeds in each hoop to quantify the seed shadow.

BUDS, BUGS AND BROOKIES (BBB)

BBB is a collaboration among UMass, Trout Unlimited, and several scientists from Harvard Forest. BBB focuses on phenology of cold-water riparian ecosystems as an indicator of ecosystem response to climate change. This project will engages anglers (Trout Unlimited members) to collect a suite of water and phenology data (flow, temperature, seasonal activities of aquatic insects, fish, riparian plants, and (later in the project) birds) when they are out fishing. Anglers will use tools similar to those used in the SeeTrees project including digital cameras, handheld data entry hardware and software. This is intended to be a long-term project, building a phenology calendar of specific cold-water riparian areas over. Data visualization tools, including Gigapans, will be a large part of the public outreach/education component of this project. The participating anglers already have a fairly good knowledge of insect emergence dates, which knowledge they use to "match the hatch". What they are less familiar with (and the general public that much less so) are the ways in which the activities and biological calendars of aquatic insects integrate with those of other flora and fauna in the riparian zone; and how these may be changing as a result of climate change. Phenological synchronicity is one topic that will be explored: as phenology calendars shift for individual species, do they keep pace with others? Or is the ecological web frayed by gaps or overlaps in the seasonality of different activities? We intend to raise these issues and stimulate discussions among the anglers and the broader community, using Gigapans as a discussion platform. Gigapan photos will be taken at different seasons each year at specified "benchmark" locations on selected trout streams. Initially, these Gigapans will be for "internal" use of project participants, including the citizen scientist anglers (http://www.gigapan.org/gigapans/51144/). Snapshots in these Gigapans can be developed to illustrate a variety of angling as well as broader ecological principles: e.g. to point out favored microhabitats for fish of different life stages, of different species of emerging insects, of different plants and birds that are particularly active in a given

season. Anglers will take supplemental "normal" photographs throughout the year of a variety of phenomena: insects, plant parts, etc. These photos will be collected in web-based photo albums (e.g. Picasaweb or similar (http://tinyurl.com/29ongdl), and linked to the Gigapans via hyperlinks in the comment fields or snapshots, as will electronic discussion forums and other scientific, angling, etc. web sites, and a growing database containing the phenology observations contributed by the anglers. Forums will be moderated with a specific intent to stimulate informal scientific discussion an inquiry into ecosystem, phenology and climate change questions. These will range from the simple ("what's that bug?") to the complex (for instance: "Do hatching mayflies require streamside vegetation to shield them from warblers and other predators? Do mayfly populations suffer if synchronicity is lost between hatch dates and leaf emergence dates? Or if other disruptions to the riparian canopy, such as gypsy moth infestations, occur?"). Those questions that are accurately and satisfactorily answered in the forums (with assistance from participating project scientists) become suitable content for inclusion in the ever-growing EFGs that project participants will build, and in a series of public-oriented Gigapans that will tell an evolving story of phenology, riparian ecology and climate change. We view this project as something of an intellectual barn-raising, wherein different participants all contribute to our growing collective knowledge of the interactions between place, season, human and environment.[6, 7]

CONNECTICUT RIVER TARGETED WATERSHED INITIATIVE (TWI)

The University is part of a consortium conducting this EPA-sponsored project that contains many components, from a citizen-science effort to track bacteria levels on the Connecticut River to the development and dissemination of a smart growth toolkit to an IT-infused public outreach effort. One element is a Virtual Tour of the watershed, which gives residents and visitors a map-based pictorial view of the resources and issues found in the watershed. (http://www.cesd.umass.edu/TWI/TWI_Projects/Virtual_Tours/index.html). The virtual tours work much like Google Maps or Google Earth: a user open icons found on a map of the watershed to view images, text, hyperlinks etc. organized according to a variety of topics, or themes. Several of the icons open up to Gigapans. Some of these are primarily for scenic value, but we are also building stories detailing the rich geological history of the CT River valley. We are creating a series of nested Gigapans to tell the story; large scale Gigapan images revealing the sweep of the valley are used to illustrate its origins as a rift valley. Narrower focused story of geologic events occurring on a smaller scale can be told by using the snapshot feature to insert a hyperlink to another smaller scale Gigapan. To date, we have tested three levels of nesting, to use in describing several geologic phenomena spanning millions of years and taking place over several geographic scales, including the initial rift, a later basaltic extrusion and valley tilting that formed the Holyoke Range and other low mountains, and much more recent glacial scouring and lake formation. These two illustrate a progressively closer view of landscape features, and have been linked via URLs embedded in snapshots (a third (close-up of Mount Sugarloaf) has not been uploaded as of this paper submission date): http://www.gigapan.org/gigapans/35755/, http://www.gigapan.org/gigapans/36130/. We envision taking this further, to include close-up Gigapans of rock faces to discuss mineral structure, rock formation, etc. in the vein of Dr. Ron Schott's Grand Forest Granodiorite Gigapan (http://www.gigapan.org/gigapans/11403/). The concept of nested Gigapans can be applied to illustrate a wide variety of concepts, geology being just one example.

STORIES OF PLACE PROJECT

The University has also been in discussions with other local academic institutions, government agencies and nonprofit organizations to develop a place-based community storytelling project that uses Gigapans as the foundational format. A series of Gigapans will be taken around the Pioneer Valley in western Massachusetts. We will then hold a series of community outreach sessions and workshops to engage different community members and organizations in telling picture stories of place, using the Gigapan image(s) of their choosing, and working with the comment and snapshot features to craft the narratives. We will also encourage interested parties to take their own Gigapan images upon which to build additional stories. We will focus primarily on science based stories that speak of the land, but will encourage participants to use their own perspectives and creativity to blend science, art, history, and the humanities in their stories. In the workshops, we will demonstrate use of the comment and snapshot features, and suggest ways these can be manipulated to create a compelling narrative (examples above, from the other projects discussed), but will also welcome new ideas on how to use the Gigapan technology as a storytelling vehicle. We will encourage interactive stories as well as more traditional author-consumer narratives. As community

creativity produces novel approaches, we will encourage replication of such discoveries by maintaining a collection of tools, widgets, mashups, etc. that expand the capabilities of Gigapans – for instance, mixing sound clips and videos into Gigapans. In this way, the project will produce a series of Gigapan images, each with a collection of stories by different community members; each giving the viewer a unique experience, a different perspective of the land that Pioneer Valley residents and visitors share.

ASPECTS OF GIGIPAN TECHNOLOGY IN ENVIRONMENTAL EDUCATION

All of these projects entail providing some value added to the basic Gigapan approach of providing "large" scale views. In some cases it involves creating a specific focus for "Gigapanners" to devote their energies, with relevant guidelines for participation (dictated by the specific project structure and objectives). Many Gigapans on the web are accompanied by a series of separate, unrelated snapshots that often point out details of modest interest (e.g. stitching errors, anonymous individuals) with no further illuminating comment. In each of our projects, we propose to develop Gigapans where the snapshot annotation tool is used in a somewhat regulated, focused, organized fashion. We will develop "sets" of snapshots; each set will have internal coherence and will address a given topic (e.g. riparian zone phenology in BBB, geology in TWI). This will require an organized human network to facilitate the effort, providing outreach, instruction, and technical support as necessary. (Although in most of the abovementioned projects, broad public participation in taking Gigapan images is not envisioned, there is still need for training and support in use of the Gigapans snapshot features and related mashups (e.g. complementary photos, Flicker albums, linked discussion forums, etc)). The organizational network is different in each of the abovementioned projects; leaders in each include course instructors at SeeTrees, University and TU leadership in BBB, the TWI consortium, and the (still emerging) partnership among local institutions in SOP. The "rules of engagement" will differ for each of these, based on different objectives, number, motivation and background of participants for each, education level, technical expertise, etc. We will be very interested in exploring this human / social part of the equation. Another thing these projects all have in common is the development of a topic-focused "community" of individuals and organizations contributing in different ways to the creation and use of multiple Gigapan images. They all use deployment schemes wherein a relatively small portion of the community takes the images, while others then view and rework the images to produce narrative and/or database content of one sort or another. To fully realize the potential of these and similar projects, we believe that some modifications to the Gigapan platform as it currently exist would be beneficial. We suggest:

- Greater flexibility in "ownership" of Gigapans; e.g. having public Gigapans, but with centralized ability to delete, organize and modify snapshots contributed by others. For instance, we want to assemble Gigapans that include a library of snapshot "stories", each containing individual or sets of snapshots, organized to produce a narrative. Individual story "authors" might themselves have several sets of snapshots, each telling a different story.
- Greater flexibility in the look of a snapshot: allow different-shaped snapshot outlines, longer text in the snapshot comment boxes, etc.
- Greater flexibility in the look of a Gigapan page; to allow for display of snapshot sets, arrange snapshots in an order different than the single horizontal line now available, change order of snapshots in a set, change the look of the comment feature, enhance organization and searchability of comment threads, etc.
- Better search algorithms for Gigapans themselves than what currently exists.
- Develop integrated mashups with other IT solutions. These are largely to be determined through experimentation, but we envision such things as a calendar and/or time slider to allow a user to find Gigapans of a certain date range, enhanced links to photo sharing and similar social networking sites, and greater integration with sound and video files.

We are just beginning to test the capabilities of Gigapan software, and do not yet know whether these recommended modifications will best occur through use of the Gigapan API, or if they are something the Gigapan developers would have to institute.

CONCLUSION

Gigapan is more than just a tool to produce highly detailed panoramic images. We think it can be an innovative way to teach people to see, to hold a community conversation and to gather scientific data. When combined with other

information technologies and deployed within human networks that provide focus and collective creative effort, and with further enhancements to the user interface, Gigapan offers exciting possibilities for a wide range of truly novel avenues for formal and informal education, for community engagement and for scientific discovery.

ACKNOWLEDGEMENTS - Key partners in these endeavors include the University of Massachusetts Water Resources Research Center, Biology departments of both campuses, the UMass (Amherst) Center for Educational Software Development, Landscape Architecture and Regional Planning department, and the MA/RI Council of Trout Unlimited and scientists from Harvard Forest and several other local organizations.

REFERENCES

1. Louv, R. 2005. Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder. Algonquin Books. Chapell Hill, NC. 323p.

2. Wandersee, J. H., and E. E. Schussler. 2001. Toward a Theory of Plant Blindness. Plant Science Bulletin 47(1): 2-9.

3. Stevenson, R. D., W. A. Haber, and R. A. Morris. 2003. Electronic field guides and user communities in the Eco-Informatics Revolution. Conservation Ecology 7(1): 3, http://www.consecol.org/vol7/iss1/art3/.

4. Greenberg, Gary. 2004. The Digital Convergence: Extending the Portfolio Model. EDUCAUSE Review 39 (4): 28–37.

5. JEyeTracker. 2010. Java based eye tracker simulator based on mouse motion. http://code.google.com/p/jeyetracker/ accessed Sept. 2, 2010

6. Gruber, Tom. 2008. Collective Knowledge Systems: Where the Social Web meets the Semantic Web. Web Semantics: Science, Services and Agents on the World Wide 6(1): 4-13.

7. Rettberg, Scott. 2005. All Together Now: Collective Knowledge, Collective Narratives, and Architectures of Participation. The Richard Stockton College of New Jersey. *Digital Arts & Culture Conference*, IT University of Copenhagen, December 2005.