The Coastal Ecology Language and Learning System (CELLS)

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Abstract

Four areas of development are converging together in society today: technology, education, science, and public policy. The expansion of computers throughout modern civilization has enabled new opportunities. Corporate America has already embraced the technology, and government is well into their full implementation phase. Education is the next realm for overhaul. Government managers on the policy level, acting in response to taxpayer impetus, are developing innovative approaches to enhance the educational system. In their wake, parents and adult community leaders are now afforded the opportunity to utilize these advances to learn more about their local ecosystem, participate in knowledge building, as well as provide direction for the appropriate utilization of regional resources.

At the same time, scientific understanding of the world has expanded in the last two decades, while the interest in science, as a choice among educational alternatives, has declined. An expanding, complex body of scientific knowledge has been developed that can help perpetuate and enhance civilization into the future. However, this body of knowledge requires the ability to apply scientific principles across a wide variety of disciplines, as well as the historical perspective to provide a context for appropriate development.

As scientific problem solving, government policies, computer technology, and education converge, children, teachers, parents, and administrators are swept into a maelstrom of mental, physical and emotional challenges. This author’s view is that technological

implementation of science learning strategies should take an integrated approach combining field studies with comfortable access to the knowledge base, while at the same time embracing technological innovation in the form of web site collaborations formed around the context of geographic spatial learning and recall.

INTRODUCTION

The objective of this endeavor is provide an online tool for educational outreach to help fulfill the mission of the Riverhead Foundation (TRF) through the use of digital technology tied with field studies built on geographic pedagogy. Three main components of the Coastal Ecology Language and Learning System (CELLS) are existing online mapping tools, existing TRF outreach efforts, and new data and tools to support the effort. The new data and tools support the mission of providing the public the opportunity to participate by giving them an online mapping tool to report marine mammal and sea turtle sightings. Furthermore, the goal of providing an educational experience is developed through the integration of the support materials with a language learning system that provides the capacity to learn new words and test their retention.

There are a variety of options for providing technological enhancement to the learning system. Based upon this author's experience implementing Geographic Information Systems (GIS) for a wide variety of users, there is a need to carefully tailor the implementation to the qualities of the audience. As one of the interfaces available to seal cruise attendees, the technology greatly affects the outcome through a myriad of influences.

It is this author's proposition that the human brain arranges itself differently over time, and that those differences are affected by the interfaces that a person may encounter as they pass through time. As a result, persons using computers and software interfaces interpret, process, and interact with their outside world differently. In a simpler sense, researchers speak of the digital divide as access and use of technology, but this author believes that it is occurs on a deeper, fundamental level (The Kaiser Foundation, 2005). In addition, digital technology in human bureaucratic systems has become an evolutionary force affecting the development of the natural systems on earth. With that in mind, this author suggests that the development of the digital environmental management system belongs in the hands of the energetic minds of the people in the community.

FOUNDATION OF PEDAGOGY

The roots of technology in society run deep and spread wide as the human species has improved its brain power over the millennia. Technology is the effective design and application of tools, given an understanding of the task to be accomplished. The introduction and development of the personal computer (PC) transformed the tool from back room experts to the distributed technofile. As technofiles got hold of the building blocks of the desktop computer systems, they further transformed the tool into a daily appliance of society. Thereafter, the empowered roles of individuals, leaders and the collective consciousness define the new directions for civilization.

The pedagogical foundations for CELLS depend heavily on the work of Vygotsky, Piaget, Papert, and Knowles. Vygotsky introduces that learning is a social activity built in succession based upon what is in the proximity of the learner (Vygotsky, 1978). By preparing citizens with the scaffolding of the fundamentals of vocabulary, mathematics, geographic principles, and scientific inquiry, the pinnacle an informed populace in marine science is achievable.

Piaget's approach of examining how infants behave and develop, then moving on up the age range to adolescence, providing a basic time line of what could be expected from the different age levels and developmental stages of human growth, is useful when designing science content that can accommodate the different age ranges and abilities (Piaget, 1952). An important aspect of CELLS is to provide a geographical context to propagate spatially relevant cognition across the range of ages. The intent is to provide an impetus for experiences with the real world that help nurture the mental connections to the mind's view of the environment while stimulating memory centers that anchor the content, and analysis centers that understand its application to similar situations.

Papert, a mathematician, provided LOGO, a computerized learning situation, which gave students the opportunity to develop computer instructions to guide a robot to perform simplistic activity (Paper, 1980). He puts the technology in the hands of the student to learn by experience and follow a personal path of discovery. The CELLS CD intends to provide a method that will put the technology and the information into the hands of the general population, along with expert instruction, to supplement the outreach efforts begun on the seal cruise field trip.

Maddux and Johnson examine the difficulties and limitations with using complicated, teacher and time dependent learning situations (Johnson, 2003). Official endorsement, enthusiastic implementation, and smooth flowing outcomes that can be measured and matched to improved knowledge in the populace are the intent of this project.

As an extension to Piaget's time series, Knowles develops a conceptual model of learning for adults (Knowles, 1998). Based on his work, CELLS intends to set a context of a reason why a person would want to know what they need to know. Generally, people who are actively interested in their community want to learn more. CELLS provides the opportunity to develop a sense of responsibility within the community, resolve the feeling that citizens are powerless over government decisions, and are instead endowed with the capability to proceed as part of a community solution. Our coexistence with marine mammals in local waters is a surprise to many people, and the thought of the human existence as an agent of cause for their suffering is often a prime motivator for the desire to learn more and support habitat preservation both monetarily, as well as with time donations.

Ablow worries that "some teenagers today are detached, like actors playing themselves in a role well scripted." (Ablow, 2005). Similarly, he states that he believes it "has its roots in a society that has drifted free from reality and is creating adolescents who are at most participant-observers in their own lives …" (Ablow, 2005). The local ecosystem habitat aspect of CELLS intends to counter that trend by providing materials firmly rooted in existing scientific studies, observations, and models of the real world, including field trips to nearby places that correspond to their in-class learning experiences.

Similarly, in an interview with New York Times reporter Claudia Dreifus, Nobel laureate Carl Wieman has "long thought that undergraduate science is poorly taught" (Dreifus, 2005). He is developing interactive animated simulations that explain fundamental scientific principles and publishing them to the internet for use by educators. One of the keys to his teaching style is to pace the student as closely as possible, allowing time for cognition to develop and ensuring that material is solidly anchored. However, while he understandably abhors rote learning, CELLS will use scripts to provide electronic flashcards to support rote learning of material to maximize the sharing of knowledge through a common vocabulary.

Dewey suggests that extending an intellectual carrot provides a positive learning situation, and CELLS intends to stimulate geographic learning by extending a visual intellectual carrot of interactive aerial photography and color information about the community (Dewey, 1916). Moreover, CELLS intends to accomplish Dewey's goal of providing proactive abilities for people to anticipate various outcomes, consequences, and ramifications. That is, to develop the knowledge and analytical intuition to support foresight of appropriate actions and behavior.

LaTour's examination of science through measurement, and the re-creation of remote realities, is a direct match for the overall intention of CELLS (LaTour, 1999). It intends to provide laboratory desk access to global science measurements, and give the human brains in front of computers opportunities to ponder the implications. His description of grids for measurement correlates perfectly to the fundamental construct behind GIS in its mathematical modeling of the world based on a standardized measurement system.

Similarly, Hayden's Power of Place brings the field of geography to the forefront as a generic system of quantifying and qualifying the world around us with a common understanding of the integrated and dependent relationships between time, space, and human activity (Hayden, 1995). CELLS builds upon the local, known, backyards of residents and defines a set of relationships and analysis techniques that extend to the greater regional area.

Understanding the transformations of social interactions and providing appropriate design is an important component of technology in education. Haraway provides a conceptual framework for a diverse social perspective by which the variety of human complexity is fully endorsed (Haraway, 1991). The social interactions of the high tech world are significantly altered by the mechanisms of communication and content. Specifically, she uses the metaphor of the cyborg as a severely limited caricature of the human condition. As a simpler alternative, a social networking system will provide varying levels of participation.

While the central tenet of CELLS is personal, self-directed constructivism, it intends to develop the capacity to bridge the gap for scientist-delivered content to match measured progress. That is, the heutagogical approach provides ample opportunity for fulfillment of personal development which can be documented on standardized examinations of capability with online vocabulary quizzes.

In his introduction to Understanding Media, The Extension of Man, McLuhan refers to the extension of our central nervous system in a global embrace (McLuhan, 1994). CELLS recognizes the importance of global affairs, the new capability to transmit and react based on sensed needs, and that the delivery system shapes the information while the participants further develop content based up its opportunities and limitations. Therefore, the local seals who share our ecosystem in the winter will be tracked back to their summer homes up north.

Along a similar vein, Adas warns that the technology can be misconstrued and misapplied (Adas, 1990). Social constructs of dominance and supplication can be exacerbated through the complexity and importance of the computer. Similarly, conquering that complexity and wielding the importance will provide the ancillary benefit of intimate knowledge of the techniques of dominance, as well as their mitigation. As Greenbaum suggests, the go-arounds that we develop for computer systems pay tribute to our individuality in a system of subjugation (Greenbaum, 1991, 2004). Similarly, CELLS will be a personal experience, reflective of geographical control, or at least with knowledge of neighborhood environmental decisions.

Castells leads us toward the self-evolution of the internet wherein the users define the development and enhancement of the system (Castells, 1991, 2004). Similarly, CELLS takes advantage of the information provided by other developers through an open and interactive forum for which the communication is open and flexible. Furthermore, by choosing to be part of the process of community management, closer attention to governmental (political) choices for the community will be a concomitant outcome. And closer attention needs to be paid. Using GIS as a highly efficient management tool for the environment brings with it new drawbacks, since it also streamlines the implementation of environmentally deleterious projects. With a history of promoting consumption of the environment through development, citizens of the region need to keep close oversight of the choices their leaders make.

In her overview, Sarah Horton's "Preparing to Teach with the Web", she gives an excellent overview to the process of delivering an online course (Horton, 2003). While the CELLS project is not an official online course requiring the submission of materials for grading, many of the issues Horton raises are pertinent to the topic, and provide caveats that could derail an educator attempting to implement an online learning environment. Institutional support, the different hats that a developer might have to wear, and the work load involved provide important examples that a developer should consider.

The Maricopa Center for Learning and Instruction (MCLI) hosted a site that created a searchable database for educators to use to find examples of "Teaching & Learning on the Web" at http://www.mcli.dist.maricopa.edu/tl/ which provided a searchable database (Maricopa, 2003). However, the geography collection tends to be simple mapping skills, as well as global geography. The Kidsea link which seemed most relevant to this author's topic was not active.

"How People Learn: Brain, Mind, Experience, & School" provided an excellent overview of the research pertaining to the learning process, as well as the recall and cross-linking of information to support critical thinking skills (Bransford, 1999). Understanding the basic brain functions and the development of educational situations based upon what works best helps ensure long term success in the educated student. This author took particular notice of the section on science in which it describes methods of increasing learning outcomes with a methodical approach, time-on-task, and deliberate practice. In essence, the CELSS project intends to mimic the methods that scientists and practitioners use to examine projects and develop solutions using real-life information and examples.

Based upon the book, “Theory and Practice of Online Learning”, CELLS is intended to be a hybrid learning system, combining behavioral, cognitive, and constructivism techniques (Anderson, 2004). The behavioral portion comes from the perspective that test performance is the goal of the educational system, and matching its needs must be a primary target. As such, teaching for the test is a goal of CELLS, so techniques of learning that improve performance are a major set of components. These include vocabulary memorization and solid anchoring of material through repetition, followed by the opportunity to explore the neighborhood mapping tools. These tools move the user into the realm of cognitive theory, in which the process of learning and performing is internalized in the participant, but played out through the interactive technology. Finally, constructivism comes into play since the information that comes from the real world, and the spatial analysis techniques that assist in its presentation and understanding, encourage the student to “interpret information and the world according to their personal reality, and”… “learn by observation, processing, and interpretation, and then personalize the information into personal knowledge.” (Anderson, 2004).

In “The Academic Culture and the IT Culture: Their Effect on Teaching and Scholarship”, Ayers struggles to define a new method of education that provides information that utilizes the full potential of the computer (Ayers, 2004). However, his layered model proved too outlandish for its reviewers, but his voyage has potential to affect the development of CELLS. While he bases his thoughts upon the discipline of history, the concept of evidence and argument is universal. The CELLS model intends to provide students and teachers with real information about their community, the theories of environmental processes, and the vocabulary to construct a meaningful dialogue.

In “Educating the Net Generation”, Oblinger calls upon Ramaley and Zia to define interaction, for which they provide four levels: people to people, people and tools, people with concepts, and people with contexts (Oblinger, 2005). CELLS mirrors their construct by providing GIS tools, contextual data, concepts of arrangement, and promotes social interaction on real-world projects.

In “An Extended Epistemology for Transformative Learning Theory and Its Application Through Collaborative Inquiry,” Kasl discusses learning through feelings and emotions (Kasl, 2002). One of the components of TRF’s web site is access to video clips of seal in a variety of settings. One of these settings is inside their hospital area where seal are rehabilitated for release into the wild. One of their clips shows a newly-arrived seal in a sad state of affairs moaning, looking around and moaning again. For this viewer, the empathetic emotional feeling helped tip the scales toward active participation in TRF’s volunteer program. Similarly, CELLS participants will be provided the same emotive opportunity to increase their level of dedication to learning the material with the expectation that it will also help guide their actions in support of the TRF mission.

Lakkala and Rahikainen bring together a number of authors to discuss Computer Supported Collaborative Learning (Lakkala, 2001). However, as a starting point for learning for the environmental science curriculum, it is not intended that the CELLS web site be used directly as a collaborative tool, rather it provides direct improvement of student outcomes through interactive learning, a source of project ideas and reports, as well as a posting location for links to local environmental happenings and outcomes. The site may evolve into a broader community tool that uses active synchronous and asynchronous communication to directly foster improved societal outcomes, but direct engagement of students or teachers is outside the bounds of the current phase of the project.

Muirhead notes that “even graduate students can struggle with a lack of confidence in their learning abilities” (Muirhead, 2004).

Similarly, community leaders often have the same trepidation, so the normal mode of confidence-building techniques will guide the development of CELLS, such as small steps, positive reinforcement, and adequate time allocated for development of the skill. The recipes for technological participation will be concise and coherent guiding the user through steps of learning while allowing for personal adaptability of the experience.

Putting map-based imagery together with definitions is the main thrust of what I am trying to do at this point, with the further proposal to set up a system where students would replicate my process for their own specific variables.

While environmental science is essentially right outside one's front door, the exploration of history requires the use of archival materials and sources. Recent innovations in digital imaging, storage, and retrieval, allow the easy sharing of rare materials beyond just a privilege bestowed upon the anointed few. The interpretation of history can be skewed by the selection of candidates granted access to the material. Now, a broad range of people with common interests can develop more independent interpretations.

Similarly, environmental science has undergone a technological revolution that brings the power of worldwide data to the average citizen and researcher. NASA's Globe Project is one example of the sharing of advanced scientific knowledge through documentation and well-developed lesson plans (NASA, 2008). At the same time, classroom participants are encouraged to establish scientific measurement instrumentation and publish findings to be shared worldwide. The NASA Scientific Visualization Studio provides support services to a number of federal researchers and administrators and publishes online video and still-picture satellite images.

In "Designing Simulations for Learning" Williams makes significant points regarding the combination of the learning process with the presentation of material (Williams, 2003). A key aspect of CELLS is that one segment of the system is designed to be a support system that provides actual memorization and recall tools to help test performance. While the final look and feel of the system will develop over time, the fundamental concept is to provide interactive tools to enhance test performance by prompting information storage and recall in the brain through a variety of methods, thereby utilizing more of the areas of the brain responsible for storage and retrieval. Vocabulary learning is by implementing on-screen flash cards, advancing to re-typing of definitions, reinforced with timed vocabulary matching. Audio replaying of words and theorem definitions with a matching task, along with downloadable audio files for pre-test and offline replay, may be included to reinforce learning.

Williams makes another interesting point in that systems that are easy to use may not result in the best learning (Williams, 2003). Following detailed steps that utilize new vocabulary challenges a user to conquer the meaning to get through with the task. And since they may not be focusing on just learning the meaning, but have more focus on the context, learners pick up and use a mental tool through a stronger, sub-conscious manner. While some developers consider interactive to be made of automatic links and cross-referenced web pages, this author considers interactivity to be a concept of the mind. As such, a project that leads a participant to use a digital camera to take a close up picture of a patch of grass in the backyard and post it to a site utilizing its geographical coordinates as a higher-resolution supplement as part of a learning process in environmental science is interactive technology and pedagogy.

When considering user satisfaction in the design of the CELLS, following the work of Zazelenchuk and Boling, the utility of the system to lead a student through the learning process in an intuitive manner, and provide feedback as to expected outcome in the form of a test score (Zazelenchuk, 2003). For example, part of the utility is expected to come from the Language Learning segment which provides users the opportunity to rank the new vocabulary they need into three categories: "I know the word definition", "I maybe need help in remembering it", and "the word is new to me". By creating personalized vocabulary lists, a participant can focus on "new words", anchor "maybe words", and set aside "known words" until the last minute cram session.

The last minute cram should be downloadable to a portable device and set up to lead a student through the material in a method that is personalized for the student, as well as for the type of test. Similarly, for new and maybe words, a downloadable flash card file can turn downtime into a useful learning situation. While simple flashing of information is within the realm of this researcher, an effort will be made to try to research and apply a word game technique.

Reville raises an important point that the delivery mechanism should not overwhelm the focus on content (Reville, 2002). In fact, this author has been focused on reviewing and developing content, and has downplayed the delivery details to date. Not that important aspects of delivery have been overlooked. Time series are an important part of visualizing environmental science theorems. This researcher has crossed numerous hurdles to examine the presentation of time series information and has settled on a rollover technique that reduces the need for video software downloads with their inherent compatibility, expense, and system administrator permissions to function.

Project List: Two additional aspects worth considering in the CELLS project are tele-robotics and video imaging. Based upon the web materials from the class, I came across http://www.pixcontroller.com/Products/PixU_overview.htm which shows how to set up a camera system that captures photos at regular intervals, or by sensing heat or motion. I am currently in negotiation to put two or three of these camera to capture biologically, and physically significant changes over time at field trip locations. These can then provide interactive technological support to enhance the field trip experience. One of the main things these would provide, besides the actual imagery, is the fundamental concept of remote viewing of science information. In addition, one of the gadget sites we were recommended to view led me to directions for the assembly of an underwater submersible. While clearly outside the time constraints of this author, this $200 project would make a great team effort for college or advanced high school students to assemble and put in the sea to capture imagery on what is under the ocean at the edge of the field trip location. While it might be interesting as a learning station at the center, it seems from the readings that making the device remotely maneuverable is completely within the limits of today’s technology.

Tying field trips together with spatial learning through the use of interactive technology that gives the students the capability to control maps, time-series imagery, georeferenced data, and remote operated sensing devices, while teaching them a methodology of spatial analysis that has applications throughout a person’s life and career, is a worthwhile pursuit. For the CELLS project, participants will be provided with direct links to online materials that will offer near real-time images and data pertaining to environmental science.

The online environment CELLS spawns has the capacity to develop over time not only as a science forum and educational tool, but also as a vehicle of public participation which can track participants, their levels of involvement, and community outcomes over time.

LOCAL ASPECTS

Long Island's is the result of a glacial terminal moraine deposited over a bed of "gently dipping coastal plain deposits of cretaceous age" (Bennington, 1999). As the glaciers finished melting, the rate of sea level rise decreased. At the same time, the removal of the weight of the ice permitted glacial rebound to occur on land, while adding weight to the land under the ocean (Carter, 1993). This process favored the development of barrier islands, which permitted the formation of marsh lands as the captured bay waters calmed and materials stabilized in deltas.

Salt water marshes along the south shore of Long Island are depreciating. In neighboring Jamaica Bay, salt water marsh loss has been determined to be approximately 40% percent in the past sixty years (Rosenwieg, 2001). In addition, a New York State study found a depreciation rate of approximately 30% along the south shore of Nassau and Suffolk counties (NYS DEC, 2008). The current definition of salt marsh incorporates historical vegetation growth and decay in a specific topologic setting (NYS DEC). Tidal flows of ocean water play a key role in the creation of salt water marshes, causing the development of channels for water to flow through thereby creating conditions in which key plants grow. As plants grow and decay in cycles, they build up and reproduce the conditions conducive to continuation. According to the work of Rosenweig, *"Wetlands and their adjacent areas serve a number of economic and environmental functions. They form a protective barrier for coastal urbanized areas, buffering buildings and transportation networks from wave impacts during storm surges (Cowardin et al., 1979; Tiner, 1984; Mitsch and Gosselink, 1993; and Bertness, 1999). Tidal wetlands can serve to improve degraded waters by recycling nutrients, processing chemical and organic wastes and capturing sediment loads; the cleansed water helps maintain aquatic organisms. The intertidal zone serves as breeding and over-wintering grounds for migratory waterfowl and other birds. Thick layers of carbon-rich peat play a role in the global carbon cycle by binding poorly decomposed plant material into the substrate (Mitsch and Wu, 1995; Patterson, 1999). Each of these wetland functions diminishes when loss of marsh acreage occurs." (*Rosenzweig, 2001).

On Friday, May 6, 2005, the Director of the Department of Science of the New York City Department of Education, Julia A. Rankin, Ph.D., gave a lecture at the New York Academy of Science entitled, "How Do We Reform Science Teaching in Urban School Systems". She provided a policy level description of her work and described her blueprint for science teaching in the school system. "*The Department is cultivating partnerships with scientists and science educators in institutions of higher learning, in museums, and other settings of informal learning. Collaborations with academic scientists will invigorate the curriculum by introducing powerful new explanatory ideas. Science educators will contribute to the curriculum designs and preparing teaching in collaborative teaching practices so that good science will be accessible to all students*" (NYAS, 2005).

On May 14, 2005, The New York Academy of Sciences hosted a presentation by its Science Education Section for Richard Steinberg "addressing the twin matters of retention and recruitment of students and majors in college science courses". Dr. Steinberg led the audience through examples of test questions that truly determine whether students have grasped the fundamental concepts contained in lessons. He has found that the properly implemented, the pedagogy of inquiry leads to a fuller understanding of the material, along with the benefit of a greater sense of involvement between participants (NYAS, 2005).

On October 7, 2005, The New York Academy of Science presented Gregor Novak discussing, "Just-in-Time Teaching: A Learning-Centered, Knowledge-Centered Assessment-Centered Pedagogy" in which he discussed a concept whereby professors construct lessons based on student's online submissions of answers to questions, which he then uses during the class. The method requires strong content mastery and specialized training to use psychologically-valid interaction techniques, but it has been found to be highly effective. It also separates weaker students from the motivated ones (NYAS, 2005).

Beyond the local aspects of educational reform, there are local developments in the technology that support the implementation and design of CELLS. The computer has revolutionized society and brought about significant changes in the way that people interact between each other, and with the earth on which they live. Millions of work hours have gone into the development of operating systems, application software, hardware devices, algorithms, and data. Based upon these efforts, single individuals and small teams can wield powerful tools and pursue advanced research in ways never before possible. A (Geographic Information System (GIS) is one such technology that provides a resource for the researcher to examine important issues and device a plan for the future. A GIS is a set of computer hardware, software and data to capture, manipulate, and display located features (Burrough, 1993). Standard methods of arranging mathematically consistent representations of the earth along with qualitative data of their characteristics in map form allow for the overlaying of information and analysis by location. Technologically-refined measurement systems allow for a high degree of confidence in the quality of the attribute data, as well as the accuracy of its location. Standards of practice ensure consistency across practitioners and allow for the combination of disparate data sources to obtain new perspectives of knowledge with a relatively high degree of integrity.

The County of Nassau, on Long Island, in New York State, has installed a network of survey control points known as grid monuments (Soehngen, 1990). These are the foundation for a GIS designed to enhance taxpayer services (Jones, 1993). Engineers developed a geoid model and established elevations for these monuments (Soehngen, 1991). There is also an existing network of benchmark elevations using techniques consistent with First-order, Class II accuracy (Bossler, 1984). These points of known elevation, along with the geoid model, establish a reference plane to examine the potential effect of the change in water levels at the coast. The 1993 GIS base map for Nassau County created over 100 feature layers, including contours, control points, and structures referenced to a standard coordinate system, the North American Datum of 1983 (NAD83), Long Island section. Over time, additional information has been added to this set of data, or referenced to it, including historical air photos that have been geo-referenced to its NAD83 State Plane Coordinate System.

The expansion of location-based services, information, and data-gathering primes the pump for the population to look for and understand computer-based geographical knowledge systems. Three main developments that support the CELLS endeavor are the release of conversion software for publishing map data in Google Earth's KML format, the online delivery of parcel-based analysis of human settlement, and the availability of accurate reliable basemaps.

GIS Transition

Fortunately, the largest portion of the investment costs of this implementation has been borne by the taxpayers already through the construction of a model of the real world in a format based on common standards. The value of this investment is approximately twenty million dollars. Any new expense comes from manipulating and arranging this data into a cohesive form that directly supports individual growth.

The software interface that has emerged as the most flexible and sensible option is the internet browser. The pieces of code have advanced far enough that experts can put together a GIS website that offers taxpayers, as well as schoolteachers, immediate access to the aforementioned model of the real world in a manner that is timely, efficient, and flexible.

In the past, this interface has served to pass information on to interested parties for specific governmental activity. In the future, with this author's assistance, this interface will be used to create and share environmental science insights, interest, and appropriate utilization.

Another facet of development that coincides with the availability of this model of the real world is the opportunity to resurrect and enhance an old way of understanding the world. Geography, the study of how things relate to each other over space and time, had become an underutilized method of instruction. It had degraded to place name memorization, although it maintained a role in teaching the basics of understanding and interpreting maps and globes.

Gersmehl propose to organize geographic theories into twelve aspects of Spatial Learning. These are:

Location – Where is this place?
Conditions (Site) – What is at this place?
Connections (Situation – How is this place ling to other places?
Comparison – How are places similar or different?
Aura (Influence) – What effect(s) does a feature have on nearby areas?
Region – What nearby places are similar to each other for grouping?
Hierarchy – Where does this place fit into structure of nested areas?
Transition – Is the change between places abrupt or gradual?
Pattern – Are there imbalances, clusters or other arrangements?
Association (Correlation) – Do features tend to occur together?
Diffusion – How do spatial patterns change over time?

These spatial theories of understanding the real world and how it changes over time mix and match to describe historical forces and outcomes, while offering the opportunity to forecast future possibilities. In addition, these spatial thinking constructs match one of the eight multiple intelligences described by Gardner. CELLS intends to develop environmental science activities that match the various segments.

HARDWARE

While the programming of internet browsers has advanced to accommodate GIS, the versions that are needed to fully operate the interface are usually the newest ones. While that software itself is often available as a free download, older systems are usually not capable of smoothly handling the full capabilities of the upgrade.

However, it is reasonable to generalize that a fair minimum would be a system designed to accommodate Microsoft Windows XP, with a standard suite package of office software, photo and/or video editing software (and any hardware to handle unique opportunities), and internet web site creation and publishing software. On top of that, broadband access to the internet greatly enhances the interaction with the information that is out there, as well as what can be created and published.

There is encouraging news on this front for New York City schools. Julia Rankin announced an overhaul of science learning labs, with a focus on providing cost-effective smaller labs in more schools, as well as improving the use and focus of the larger, full-scale labs. This author walked away with an understanding that computer technology will play a crucial role in these labs. Similarly, Dr. Rankin suggested that as the new science curriculum is implemented, every sixth grader will be provided with laptops. (If I remember correctly, I could barely hang onto my baseball cards in sixth grade, but I am not one to be a naysayer.)

While there are advances on the technology front, there is also the opportunity for Johnny Appleseed Visiting Experts who can plant the seeds of science throughout a school system. A mobile technology system could be put together which would allow for in-class presentations and interactions with students. This author envisions a plan that encourages students to involve themselves with science, and in this case, the real world.

The key to the presentation is to provide real world applications of the material that match the questions that students will be required to answer on the regent's exam. This author reviewed earlier Environmental Science exams and found that understanding certain key examples exposed students to a variety of needed skills. Five examples with their tangential explanations could provide bread crumbs toward twenty five test questions.

Technology is not just computers and software. There are a host of technologies that provide efficient opportunities for the exploration of science. Large screen displays allow for dazzling, high definition presentations, while large screen desktop terminals help avoid eye strain. This author has to mention that sitting at a desk computer could classify as medieval torture, but is currently beyond his manufacturing expertise to implement a digital pod (d-pod?).

Digital image capture devices, in satellites, planes, telescopes, microscopes, and point-and-shoot cameras, offer the opportunity for the student and teacher to personalize their creation and presentation of the material. This author used a video camera to capture a cardinal feeding its young one lucky spring when the nest was two feet out his front window. The bird landed to feed its young, and regurgitated a large insect into the first, forceful, hungry chick. It then regurgitated partially digested material for the next young while the first struggled with its overfull stomach. The youngster thereafter regurgitated the insect, which the parent quickly snatched up, and flew away to further digest and utilize while it searched for more food. Who knew that chicks could serve as a food warehouse?

This potentially unique insight into a biological process could be ground-breaking science and potentially reward a student with a scholarship, as well as lifelong desire.

One of the main topics of Dr. Rankin's presentation on the development of science curriculum for New York City was the need for Professional Development. Many people are still shy about computers. An educator who has spent years developing and refining a flow of course material may hesitate to adopt computer technology, and even one who is computer savvy may hesitate, due to prior experience on the "bleeding" edge of innovation. That said, it is becoming increasingly clear that innovation is entering the mainstream, while the lessons of the past are being evaluated, and the computer generation embraces and effectively utilizes its capabilities with a greater benefit than cost.

Professional development in the form of training, education, turnkey development, and the normal turnover of personnel will support the overhaul implementation of technology in schools. This author is opting to digress at this point into his own insights into technological training and administrative bureaucracies. While a top-down approach is essential to starting and monitoring the advance of the overhaul of technology in an administrative system, the personal characteristics of the individuals also play a role. As stated above, people come into training and implementation with unique characteristics, while administrators tend to look at implementations on a single, system-wide level. A hybrid approach of system-wide training, coupled with individual support, is the actual success strategy.

One unique issue of implementing technology in education is the case when the student knows more about the technology than the teacher. In effect, the teacher is the student. This role reversal may hit traditional teachers hard, therefore special attention to this hurdle must be fully examined and mitigated in advance. The teacher remains the expert of the material to be learned, but enters into a bargain with the student on the technology. This author would need greater research and personal experience before commenting further on this issue, but it is a strong enough topic to mention.

Similarly, the teacher's unique contribution to the curriculum flow comes under re-evaluation on another of Dr. Rankin's announcements, that the reform of science education will include the implementation of uniform and spiraled scope and sequence. There is a block of knowledge out there that far surpasses the teacher's ability to pass to the students, as well as the student's ability to absorb. While Dr. Rankin describes her role as one of a filter, I believe that a better representation or analogy would be that of catalyst. Her description of the general issues is that there is disrespect for Math, Science, and Engineering. She cites Vasquez of MIT that there is a tendency to displace science with reading and math. What Rankin suggests is that if they are reading, it should be about science, and the same goes for writing. If they are learning math, it should be to work out scientific examples. To this author, it makes great sense, and it is about time.

Similarly, a field trip should be more than a day wandering through the beach nature center. It should have a semester-long curriculum with a moving focus on each of the normal subjects of learning presented in the context of the nature center. It would provide a medium for what Dr. Rankin calls, the "integration piece" and could include science journals for writing, lab reports for analysis, after-school programs, and math applications.

She brings into the picture Vasquez's work with the St. Louis schools where there were 70% improvements in reading and science after she instituted an integrated approach. Due to the mobility of students in modern culture, one example was Hartford, CT with a 40% rate, there will need to be a new emphasis on a sequence curriculum with time and pacing that permits transfers between classes and schools. Four other topics should describes in her lecture are Leadership, Institutional Buy-in, extensive Professional Development, and Review and Feedback for what is working and what is to be improved.

New York scores low on fourth and eighth grade standardized tests, somewhere in the neighborhood of 50%, with less regents in Chemistry and Physics, and Dr. Rankin wants to understand and solve the problem of why. One unfortunate issue which she described was that the standardized test scores for NYC school are not currently shared. As a result, since there is no data, there is no assessment, and there is no strategy for improvement.

In her talk, she transitions to raising plants, and butterflies, and their life cycles. She describes a pedagogy that starts with the objective of *engaging* the student *first* and then exploring the subject and providing standard teaching materials. This method pulls out the prior knowledge of the students, allowing for the teacher to advance their understanding, rather than following a script of that whole topic. As an example, she describes a method of learning electricity wherein the students are provided with wires, bulbs and batteries, and told to play with them until they can provide an explanation of what can happen when things are connected different ways, and then are invited to come in the next day with a new experiment to try out. This type of teaching methodology tends to *grab* the student while still requiring the need to teach and guide, but the impetus comes from the student's questions, rather than the other way around. She cites these findings as coming from the University of Pittsburgh's Institute of Learning.

While a technology implementation on its own can be a challenging task, coincident curriculum reform takes full advantage of the upheaval to implement a completely new pedagogy. This integrated approach will need a wide variety of technology, curriculum, policy, and implementation expertise. Dr. Rankin offers a regional approach to the plan, with regional science advisors, pilot schools, cluster teachers, collaborations with Queens, Hunter, and City Colleges, as well as other non-profit institutions, and the formation of a Science Task Force to develop, advance, and refine strategies.

Part of the thrill this author obtains from being involved in learning is the tendency to expand my information gathering into new arenas. For example, without this class, I probably would have changed channels right over the Teacher of the Year describing his experiences with winning that honor. One method he ascribed as important to developing his students was game playing. Fortunately, the computer game playing industry has made impressive strides into model building, and role-playing. The future of computer game playing in science may not be as captivating as virtual violence and sex, but it will be captivating in a sense that uniquely qualifies its participants to expand their role as managers of society of the future.

Another important concept that the Teacher of the Year espouses is the commitment on the part of his students to: "No Excuses". This author has a firm belief that the level of education of a given student in a given year has effects beyond the immediate standardized test. By making one strong statement to his students, he relieves them of the burden of reliance on well-concocted and delivered excuses for lack of performance. I must mention that this author's current paper-writing process falls under the direction of that teacher's firm belief in the power of "No Excuses." Onwards!

One issue pertaining to game play in education is that it allows students (and teachers) to choose and explore different roles in the game. This author envisions a Coastal Ecology Language and Learning Systems that has a number of role playing options for the participant. One could model the roles of the various flora and fauna, of human families, of key governmental or business decision-makers, and play out the consequences over time to generate winners and losers.

Similarly, assessment is another area in which technology has an influence. Standardized tests create comparable statistics, as due the myriad of personal demographics of teachers, students, families, and administrators. Each different component in the evaluation of an outcome can be viewed and analyzed for important influencing factors.

In the case of CELLS, the assessment method for outcome measurement is to be the Environmental Science regents, although there is need for surveys of teachers, museum staff, students, policy makers, and other interested parties to understand their opinion and evaluation of the program. The web-based surveying methods described in class will be researched and used for this portion of the implementation. This author is a firm believer in the power of continuous refinement and improvement.

Another aspect of game playing which would not take a multi-million dollar programming effort could be to set up a challenge between school districts for the eighth grade exit projects, as well as their Environmental Science regents. As the computer networked society evolves, this author believes that intelligence and accomplishment will expand as important peer evaluation systems. In the past, communication and understanding was real-time and one-on-one personal. This necessity gave competitive advantage to good-looking persons with real-time wit and good personal style. With computers networking people, and serving as a medium of communication, deep thinkers who may not look good, will have an expanded role in the virtual schoolyard.

Another part of the integrated approach to teaching science is to bring whatever resources that play a role into the forum. For example, this author attends conferences where federal employees distribute free posters and other educational materials. Two examples are the Landsat Poster, and the Earth Observing System globe. These tools help distribute the learning process into different parts of the brain, and can serve as touchstones for a wide variety of learning topics.

Similarly, the field trip can serve as a touchstone for a wide variety of learning objectives, and offer the student the opportunity to develop and express their unique combination of multiple intelligences.

CONCLUSION

Technology has the capacity to enhance and support field trips, broadening the understanding of science, while improving return on taxpayer investment in education. Gregorian describes that "the challenge calls for integration and resynthesis of the compartmentalized knowledge of disparate fields for the ability to make connections among seemingly disparate disciplines, discoveries, events, and tends, and to integrate them in ways that benefit the commonwealth. It means promoting a multidisciplinary and interdisciplinary approach to education that integrates the sciences with humanities and social sciences."

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