# Learning with GIS While Learning about GIS: The EAST Way

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Abstract:
Students participating in the Environmental and Spatial Technologies (EAST) Project apply GIS in project-based classrooms across the U.S. To learn about GIS and how to use it, students attend workshops led by experts from the Center for Advanced Spatial Technologies (CAST). These workshops are based on constructivist educational theory, where students learn in a way that builds new knowledge based on prior knowledge through their own inquiry. Students learn how to apply GIS in a problem solving context, additional skills such as team work, public presentations, and identify their leadership qualities. It is intended that these students, having gained confidence learning through the CAST model of geospatial instruction, will take their newly constructed knowledge and skills with them and assist their classmates in constructing their own.

## EAST

Environmental and Spatial Technologies (EAST) is a high school initiative for project based learning that uses emerging technologies as a strategy for solving community oriented issues. EAST began in 1996 in Greenbrier, Arkansas and has since expanded into over 250 schools in six states. Students work in groups or alone on projects that have relevance to their local community – be it fire hydrant mapping, creating videos on drug awareness or road safety. They have access to many of the latest and greatest technologies to help them solve their community issues, during which they learn many valuable life skills as well as advanced technologies that will serve them in their future careers. One of these technologies is Geographical Information Systems (GIS). GIS fits extremely well into the EAST initiative since so many community issues have a spatial component to them.

## CAST and EAST

EAST is unique in that teachers do not instruct students directly, instead they become true facilitators that guide and motivate the students to challenge themselves within a project. When students require geospatial technologies in their projects, students must both learn GIS and how to apply it to their projects. Learning GIS is an involved process. Students must become familiar with the software interface, learn about data, the capabilities of GIS, and how to apply their learning to overcome challenges within their individual or group projects. This is where the Center for Advanced Spatial Technologies (CAST) becomes involved.

CAST is part of the University of Arkansas and is dedicated to research and education in geospatial technologies. The Center focuses on three basic areas: education, research and service to the public. CAST provides high quality university courses in geospatial theory and methods. This year, CAST received over $2 million through multiple grants for research in a wide variety of research projects within Geomatics and Remote Sensing, Visualization/Animation, Environmental

Studies, and Archaeology and Historic Preservation (2003-2004 Annual Report).

EAST and CAST joined forces in1997 with the first formal training for facilitators and students. Since then their partnership has grown in leaps and bounds. In the academic year 2004-2005 CAST provided 22 geospatial training sessions to EAST students.

Training

The CAST model for geospatial training is rooted in constructivist educational theory. Constructivist theory promotes learning in a way that students build new knowledge based on prior knowledge through their own inquiry (Association for Supervision and Curriculum Development, 2005). This building of new knowledge is assisted by a facilitator, trainer, or teacher. Rather than being passive receivers of geospatial knowledge, the EAST student actively develops their skills while working on meaningful applications of GIS.

Since many secondary students have no prior knowledge of geospatial science prior to attending the workshops described below, CAST provides an online “School Mapping Project” that allows them to become familiar with GPS and GIS, thereby providing a foundation on which the students can build upon during their workshop attendance.

After students complete the prerequisite "School Mapping Project," there are six geospatial trainings at three levels available to EAST students from CAST – introductory, intermediate and advanced. Our Regional Trainings are designed as a two day introduction to GIS and GPS so that the students become familiar with the interface, allowing them to apply basic skills to their projects. The Geospatial Projects Workshop is a project driven course, taking place over three days. The students have one day of theory followed by two days of applying that theory to a site-location analysis GIS project.

Our advanced classes are two days of theory in practice offered on several topics including vector GIS, raster GIS, cartography and image analysis. These facilitate students solving more complex spatial issues and understanding all of the capabilities of GIS. After these courses, students are able to explore the GIS software in order to answer spatial questions and solve issues that arise in their projects.

In more traditional settings students learn GIS through teachers in a linear, top-down fashion. Since facilitators in EAST are not teachers in the typical sense, this method of exposing students to geospatial technologies is not viable. EAST and CAST agree that training students in a constructivist method is the most efficient way to enable them to apply geospatial technologies to their projects. Since EAST has over 15,000 students enrolled, training all of the students would be extremely time consuming and expensive. With this in mind EAST utilizes “seed training”.

In the “seed training” method schools send two students to training classes, allowing CAST to train up to 11 schools in classrooms with capacities ranging between 18 and 22. The students then return to their school and share their knowledge with other students in their class thus becoming

trainers themselves.

As depicted in the learning pyramid (Figure 1) learners only retain about 5% of what they hear in lectures. The amount of retention increases with demonstration at 30%, and practice at 75%. The highest retention rate comes with teaching others. CAST's "seed training" is a means of economically reaching many students through a few. Yet in requiring the students to bring their new skills home and teach others, they gain much more from the workshops than if they merely attended and applied the skills on their own. As students teach their colleagues at home, they find that geospatial skills become embedded in their personal knowledge base.

Figure 1: Learning Pyramid. National Training Laboratories, 2004

As discussed, CAST's main philosophy for training students is not to simply spoon feed GIS theory and application. Instead we believe that students learn through making mistakes and thereby incorporate such instances into our curriculum. For example, an awareness and basic understanding of coordinate systems are essential for understanding the placement of data. Rather than lecturing, discussing, or demonstrating how coordinate systems work, CAST trainers allow students to add data from mismatched coordinate systems (such as UTM and State Plane) to an ArcGIS project so that the layers fall completely out of line. In this situation the students find themselves in need of knowing how to "fix" the problem.

The CAST trainers take this opportunity to discuss coordinate systems with the students. Then the students look for, and find the correct coordinate systems of each feature class or shapefile in the metadata and define a projection. Through this process they gain further understanding of coordinate systems, become familiar with using metadata to gather information about their data and are made aware of ArcToolbox. While creating "opportunities" for students to learn from their mistakes, CAST trainers are careful not to cross the line of creating highly personal frustrations that interfere with the student's desire to press on.

CAST and EAST also believe that interaction and brain storming within a class is essential to build student confidence and comprehension of GIS. During the Geospatial Projects Workshop the students find the best location for a youth center in a local town. Using their own knowledge or perceptions to construct knowledge the students decide on appropriate criteria for locating a youth center. These criteria usually include proximity to the school-aged population, away from bad influences such as bars and liquor stores, close to main highways (but not too close), and on available land that can be built upon. From there they must discover where to obtain data and learn methods to process and analyze it to create new information that can be used to find the most suitable youth center location. With students deeply engaged in the decision-making processes their understanding of the broader picture increases while they remain engrossed in the project.

Learning is a social activity and teamwork is an essential skill that students learn through their participation in EAST (Brooks and Brooks, 1999). During CAST's training sessions students are divided into groups of two to four people encompassing various ages, schools, backgrounds, and

skill level. Throughout a project the team will delegate different tasks to each member so that the project is completed more efficiently. Students also have regular communication so each member is familiar with the rest of the team's tasks.

Students are empowered to ask their own questions and seek their own answers - from the trainers, from each other, and from any other resources they can find. A CAST geospatial workshop is not quiet. The workshop resembles less of a classroom and more of a worksite with students moving together to plan their course of action, making phone calls to verify data sources, and moving about to assist each other when they come across obstacles.

For example, one member will search geospatial data online, while another will prepare a table for geocoding, and yet another member will be adding data into ArcMap for analysis. Once students move further into the project, the team members will divide the different analyses between them. Each student learns various skills, which they share within their team. During this process some students discover their leadership skills. They learn how to lead without overpowering another team member's opinions and ideas. Once the project is completed the team is responsible for presenting their project to the rest of the class. Each member has to speak and respond to questioning and therefore learns public speaking skills.

Within each training session students have wide range of experience and learning skills, making each individual session unique. Since the students will return to their class to share their experience and become the "geospatial experts," the trainers from CAST provide the context that allows every student to learn, rather than trying to share a set list of geospatial theory and methods. Trainers go at the speed of the class in order for the students to learn and understand to their best ability. Enough repetition with enforced mistakes is included throughout the session for students to be able to recall the information at a later date.

## Applicability & Conclusions

In the 21st century, learning is not a linear process. Applying GIS in projects is a complex process which defies linear methods of top-down teaching. Through the CAST geospatial workshops, students have found themselves taking many twists and turns through multiple learning experiences. Students make and correct their own mistakes. They find their individual as well as team strengths. They research, analyze, and interpret data for themselves. They have worked in an environment where they have been encouraged to create and explore. It is intended that these students, having gained confidence learning through the CAST model of geospatial instruction, will take their newly constructed knowledge and skills with them and assist their classmates in constructing their own.

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