Development of Sustainable GIS Use by NASA Explorer Schools Teachers

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Abstract

- This paper will present implementation examples and formative evaluation findings from the Visual Instruction Support for Inquiry-based Odysseys in NASA Explorer Schools (VISIONES) project, a professional development opportunity funded by the NASA Explorer Schools program. The goal of the project was to develop GIS literacy in teachers and students and sustained use of the technology at participating NES schools. This paper will review lessons learned from working with a single cohort of 30 teachers and students as they constructed community mapping projects with ArcExplorer–Java Edition for Education over a one year period. A focus of the paper will be the barriers teachers experienced in implementing GIS as an instructional technology and how the project worked to help teachers overcome those barriers.

NASA Explorer Schools (NES)

- The NES program supports incorporation of NASA content and programs into selected NES schools. Teams of teachers with the support of a school administrator are eligible to apply to the program. Accepted teams spend three years in the program, during which time they develop and implement a technology integration plan in their school. NES teams are provided with access to educational resources, such as lesson plans, NASA scientists and education specialists and tested lessons. Teams are given a budget with which to purchase technological tools required by their technology integration plan. In addition teachers in the NES program are given access to professional development opportunities that address content and pedagogical knowledge.
- The NES program focuses on grades 4-9 and underserved populations of students.
- More information about the NES program can be found at their Web site: http://explorerschools.nasa.gov/

VISIONES

- Visual Instruction Support for Inquiry-based Odysseys in NASA Explorer Schools (VISIONES) is a project of the Center for Image Processing in Education (CIPE), a grantee of the NES program. The VISIONES project was designed to provide two opportunities for NES teams.
  - CIPE provides professional development opportunities for NES teachers including two intensive summer GIS workshops, one in the summer of 2006 and the next in the summer of 2007. At these workshops teachers are introduced to using GIS as a classroom tool to teach science concepts. Teachers receive training in GIS, image processing and analysis (IPA) and remote sensing, as well as field-tested, classroom lessons. They are given GIS and IPA software as well as lessons developed by CIPE, ESRI and Lawrence Hall of Science.
  - CIPE also provided NES teachers with online GIS training and technical support throughout the year. Teachers from NES schools are invited to apply for an online course designed to develop skills in GIS, data collection, and scientific analysis. CIPE use an E-learning system to facilitate the course. NES teachers are taught to use GIS with tested lessons, then are invited to collect point-data that is used to generate a GIS project to describe some aspect of their neighborhood.

VISIONES

- The goals of the VISIONES project are to:
  - Hook teacher and student interest by inviting them to investigate an aspect of their school or community that appeals to their sense of scientific curiosity,
  - Empower teachers and students to use professional-quality data analysis tools, by developing GIS literacy,
  - Engage students in experiences with authentic research and data,
  - Promote the use of visualization tools to achieve national and local standards for STEM education, and
  - Promote sustained use of the technology, by encouraging teachers and students to undertake projects that, while providing answers to questions in the short term, also invite questions that require more time dedicated to the project or a steady increase in GIS skill level.

VISIONES E-Learning System

- The VISIONES E-Learning system, Moodle (Modular Object-Oriented Dynamic Learning Environment), is an open-source course management system that supports creation of online learning communities.
- It can be used to provide assignments to participants, assess their progress, coordinate communications, provide mentoring, and offer technical support (Moodle.org 2007).

Implementation Examples

- Broughal Middle School, Bethlehem, PA
  - Historic building survey
  - Rainwater run-off
- Kenneth J. Carberry Intermediate School, Emmett, ID
  - Open water sources and mosquito populations
- Oak Grove/Jack Weaver School, Murrieta, CA
  - Water resources
- Village Academy High School, Pomona, CA
  - Emergency facilities in Pomona

Challenges and Strategies

- Some of the challenges to implementing GIS technology in the classroom have been described by others (Kerski 2003; Parsons 2005). Here we describe some of the challenges faced by teachers in the VISIONES project and strategies we used to address these challenges.
  - Prior research and previous experience indicates that a number of teachers have difficulty mastering the operating system and software skills required to manipulate files and use more complicated GIS software. We employed two major strategies to help avoid problems in this area. Firstly the choice of GIS software, AEJEE, which runs on Windows and Mac-based computers enabled teachers to work in the operating system with which they felt most comfortable and had best access. Secondly we required that teachers in the program complete a short exercise aimed at assessing general software skills, file manipulation skills, and computer system requirements.
  - A related difficulty faced by teachers attempting to integrate GIS into their classrooms are the often daunting, bureaucratic obstacles to software installation on school computers, allocating network and server space for student work, and overcoming security issues. Since AEJEE is a relatively simple program many of these issues were avoided in the VISIONES project. The teachers recruited to the project were largely educators who had a passion for using technology and were therefore more experienced at navigating these types of obstacles.
  - Understanding how to acquire geospatial data and prepare it for use in localized GIS projects is another major hurdle facing the novice user. During the VISIONES project, with the exception of the data that teachers and students collected themselves, layers used in projects were restricted to readily available TIGER Census data and TerraserverUSA images. Instructions to access these data layers were given to teams. Despite these restrictions most teams required technical support, provided by CIPE staff, to integrate the data layers into their projects.
  - Previous experience with teacher professional development in GIS has indicated that some teachers have difficultly knowing how to interpret mapped representations of information and make spatial and time-referenced comparisons of data. Teachers recruited to the VISIONES project largely faired well at interpreting map data. Most teachers had some experience working with either maps, GIS or GPS in the past.

Challenges and Strategies

- Many teachers have not acquired the knowledge and skills needed to develop a research question that can be answered with GIS. In the VISIONES project teachers were required to complete a number of examples of GIS projects that used data to answer scientific and geographic questions. In developing their own projects teachers were required to restrict their data collection to point data layers. Each data collection strategy was submitted for approval by the project staff. This way we could provide feedback to the teachers as to the relevance of their data to answer scientific and geographic questions.
- Teachers often find making time to learn and then integrate GIS-based learning into an already packed curriculum an insurmountable challenge. Teachers in the VISIONES project were not required to integrate their projects into their regular classes. While some teachers managed to do this, others decided to create extra-curricular student groups to take part in the project. This approach meant that students had an above average interest in the project and that teachers felt more able to experiment, and make mistakes, with their students – an essential component of scientific inquiry, and often lacking in science classrooms. Allowing teachers time to practice and become more comfortable with the techniques and technologies they have learnt, and to begin to understand technology as a tool, is expected to lead to higher rates of implementation in the long term.
- One component of teacher professional development that must be accounted for in fulfilling the expectations of a project is teacher attrition. By providing online instruction for teachers we hoped to be able to over-recruit for the project, without affecting the budget of the project. Teachers were required to sign a letter of commitment to the requirements of the project. In addition periodical incentives were offered to both teachers and students who fulfilled the requirements of the course. Despite these attempts at maintaining interest and commitment, the VISIONES project experienced attrition at a rate similar to other GIS professional development programs directed by CIPE.

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