

LIONS: Making After School Spatial

Bob Coulter

Litzsinger Road Ecology Center

Missouri Botanical Garden

St. Louis, Missouri

Project Overview

Local Investigations of Natural Science (LIONS) is one of 16 projects funded by the National Science Foundation¹ under the Academies for Young Scientists (AYS) program. NSF-AYS is designed to explore the potential for out of school programs to develop student interest and capacity in science, technology, engineering, and mathematics (STEM). The underlying premise is that done well, out of school time (after school and summer) programs can help to increase the pool of students prepared to enter STEM-related fields.

Within this context, LIONS tests the hypothesis that engaging students in their local community can provide a learning context that is both authentic and motivating. This approach, often referred to as place-based education (Sobel, 2004, 2008), has great promise in bridging the all-too-common gap between real-world and textbook learning. To that end, it is important to note research that finds 99% of people able to perform tasks such as selecting the better buy in a supermarket, while only 50% can do so on a math test (Lave, 1988), and other studies documenting “learning disabled” students conducting and publicly presenting thoughtful research on authentic community issues (Roth and Barton, 2005).

Thus, LIONS is designed to contribute to the NSF-AYS agenda of developing productive models for STEM-rich out of school learning experiences, while it advances the state of the art in place-based education. It seeks to do this by exploring the ways in which advanced technologies can be deployed to support students’ engagement with their community. The end result of this work – consistent with the broader NSF-AYS funding goals – is expected to be increased interest and capacity in science, technology, engineering, and mathematics.

LIONS is based at the Litzsinger Road Ecology Center (LREC) in suburban St. Louis, Missouri. This outreach facility of the Missouri Botanical Garden is the operational center for several programs that advance place-based education. In turn, LREC is one of the lead organizations in the Place-based Education Evaluation Collaborative, a national group of projects collectively researching the benefits of place-based education (PEEC, 2008). Through this affiliation, LIONS can benefit from and contribute to the growing base of best practices in place-based education.

In addition to the Missouri Botanical Garden, current program partners for LIONS include the Massachusetts Institute of Technology and Environmental Systems Research Institute. Additional technical expertise is provided by American Forests (for urban forestry), the Jane Goodall Institute (for service learning), and PEER Associates (for program evaluation). School partners include the University City, Missouri school district, two private schools in University City (Christ the King Catholic School and the Freedom School), and the middle school in the Waynesville, Missouri school district.

Year 1: Hesitant Beginnings

NSF funding for LIONS was committed in September, 2006. Initial programming was to begin in January, 2007 with two science leaders from each University City district elementary and

¹ All opinions expressed here are those of the author and not necessarily those of the National Science Foundation. This work was funded under NSF grant #ESI-0639638.

middle school (7 schools in all, with 14 teacher leaders). Teachers in this cadre were to recruit students and lead weekly after-school programs in the spring of 2007 and through the 2007-2008 school year. In addition, a two week summer program was planned for all students, to be held at a common site. The central location for the summer program allowed students from different schools to mix with each other and benefit from a greater range of teachers' interests and expertise. The summer program was also designed to provide teachers with the time and space to teach from their interest and expertise, which is quite often not possible in a school context given the curricular constraints imposed by school accountability measures.

In practice, the recruitment of "science leaders" did not go as planned. Only two were identified; the rest of the teachers were recruited at the last minute by way of a cryptic e-mail sent by the former district science coordinator to dozens of teachers, offering employment to the ones with the earliest time stamp on their e-mail reply. Since the e-mail didn't communicate the name or scope of the project, the time commitment, or compensation, it didn't get many replies. Subsequent 1-1 recruitment by the science coordinator brought 3 additional teachers into the fold, each of whom identified herself at the orientation meeting as not feeling comfortable teaching science. Given the slow and inadequate recruitment, the LIONS project director recruited a teacher from a local Catholic school to participate, as well as a gifted program teacher within the University City district that the science coordinator hadn't approached. In all, 7 teachers started this first phase of the project.

Since most teachers in this initial phase of the program didn't feel comfortable engaging students in STEM-rich investigations, and the fact that very little time was budgeted for foundational professional development², the baseline Spring 2007 programs were kept quite modest. In most cases, schools pursued Journey North's Mystery Class project, in which students compare local observations with clues from distant sites to identify ten mystery sites. In cases where teachers felt more comfortable with science, other activities focusing more deeply on local ecology supplemented or replaced the Journey North investigations.

For the summer phase of the program, several of the project teachers generated a two-week course offering. From this menu, students chose both a morning and an afternoon class:

GeoBirding (a.m.): Students investigated local habitats and made bird observations within those habitats. Students also learned geocaching and placed a geocache in a local nature area.

Environmental Detectives (a.m.): Students learned how to conduct a variety of environmental tests and applied these skills to investigate local environmental issues.

Lights, Camera, Action (a.m.): Students learned video editing and production skills as they made commercials about favorite aspects of their community

U City 2032: Imagine the Future (p.m.): Students learned to integrate a variety of geospatial tools with first-hand field experience to identify aspects of their community they liked and to envision how they would like to see the city change over the next 25 years.

Calling All Weather Forecasters (p.m.): Students learned how to collect weather data locally and online, and used those skills to create weather forecasts.

While these projects were generally successful, several elements needed to be addressed as LIONS moved forward into its second year. These included scheduling the summer program so

² This lack of foundational professional development time was based on the assumption that the participating teachers would be confident and capable science leaders. In practice, the teachers selected by the district needed much more professional development in content and pedagogy.

that students who are mandated by the district to attend summer school would not be excluded, and increasing teacher capacity so that all teachers can develop and lead programs.

As a general statement, the introductory projects in Year 1 provided an engaging and “safe” start for the teachers, but the goal for year 2 was to significantly enhance the academic level of the program offerings.

Year 2: Retooling and Moving Forward

Given the challenges of getting the first group off the ground, several administrative changes were made. First, the project director assumed responsibility for staff selection in April 2007 when the district science coordinator only found 3 of the 14 teachers the district committed to employing for a second cadre (scheduled to start in August, 2007). The first cadre of teachers also became smaller than expected, as they lost three members whose duties within the district changed. One of these role changes has proven to be beneficial in the long run, however, as the teacher became the new district science coordinator.

Subsequent out-of-district recruitment for the second cadre brought an additional six teachers to the project, two of whom left the project in the fall when their district shifted from an enrichment model for after-school programs to a remedial model focusing solely on test preparation. Greater efforts were made to ensure that the premises and expectations were more clearly communicated to this new group, and brief pre-employment discussions focused on how teachers either already implemented project-based, community-focused instruction in their school, or saw this as an area in which they wanted to grow.

Given the small size of the teacher corps, members from both the first and second cadres met together for an intensive week of professional development August 6-10, 2007. In all, 14 teachers invested a full week in learning geospatial technology skills, developing curriculum projects appropriate to an after-school setting, and designing service learning projects.

Programs in 2007-2008 school year focused on the following major areas:

Phenology: Many teachers continued to use Journey North materials to study seasonal change, drawing primarily on the tulip monitoring project, butterfly migration studies, and the “Mystery Class” project. In most cases, teachers were able to extend their investigations past the basic form presented by Journey North. For example, teachers in three schools extended their Monarch study by raising monarch larvae and watching them emerge as butterflies. Teachers used printed and electronic maps to develop a spatial component to the studies as they supported students efforts to track sightings of migrating Monarchs and emerging tulips. A number of geographic references were used to identify the locations in the Mystery Class project.

Citizen Science: Students in two schools used elements of the Bird Sleuth curriculum from the Cornell Lab of Ornithology. In Bird Sleuths, students investigate local bird populations and share their data with scientists at Cornell. This data can then be plotted quantitatively and geographically. In collecting their data, students develop spatial thinking skills as they use reference materials to view range maps. Based on the success of these programs, Bird Sleuths will be offered to all LIONS groups in the coming school year.

Geospatial Analysis: In addition to the geospatial components of the phenology and citizen science programs, students in several schools engaged in additional geospatial inquiry as they mapped features in their school yard or community and/or participated in geocaching activities. One middle school used the CityGreen extension to ArcView to calculate the economic and ecological value of the trees. A sixth grader at one school completed an independent study project to extend her work in her summer UCity 2032 course, mapping racial and socioeconomic

change in the city over a 50 year period. This project will be featured in the keynote presentation at ESRI's User Conference in San Diego in August, 2008.

Equations: Students from most schools participated in the annual Equations competition held each spring in University City. Using modified rules from the commercial Equations game, students use specialized dice and a playing board to compete against their peers from other schools. Through this play, students experience mathematics in an academically advanced but recreational context, and develop pre-algebra skills that are a gateway to STEM careers. Specific to the University City district, the involvement of the LIONS groups engaged a much more socioeconomically diverse population than has been typical for Equations participants from the district.

Augmented Reality Games: In January, 2008 the Massachusetts Institute of Technology (MIT) joined LIONS, replacing Washington University as the higher education partner.³ The Scheller Teacher Education Program at MIT has worked to develop uses for hand-held computers to extend students' ability to investigate authentic or simulated local issues. These "augmented reality" (AR) simulations support the LIONS program goals as they engage students in technology-rich investigations of the local community and provide exposure through the simulations to a variety of STEM careers. Students at two University City schools pilot-tested use of the AR simulations. From there, a dozen students will participate in a summer program going deeper with the simulations and work in teams to design their own. All students will be offered opportunities to participate in the program in the coming school year.

Evaluation

Program evaluation was conducted through two channels. There is a comprehensive evaluation underway that encompasses all 16 NSF-AYS programs. LIONS contributes data to that project in the form of teacher and student surveys, with the goal of evaluating the larger AYS initiative. To complement this cross-program evaluation, LIONS contracts with PEER Associates, a firm that specializes in evaluation of place-based education programs. PEER and the LIONS staff collaborated on the development of student and teacher survey instruments that collect data at the beginning and end of their involvement in the program.

In both cases, it has proven to be exceptionally difficult to capture student survey data upon departure from the program. Most often, the LIONS staff is notified that a given student left the program (or even the school) 4-6 weeks ago, with no hope of getting them to complete a survey.

In order to gather formative data on the project, the PEER Associates staff conducted focus group interviews with teachers and students in the summer 2007 program, and interviewed all but one of the teachers in the 2007-2008 school year program. While a more thorough analysis remains to be done this summer, major findings in the preliminary analysis of the survey data shows that teachers:

- are becoming more enthusiastic about teaching STEM disciplines
- see high levels of student engagement
- find value in project-based learning
- report growing impact on their in-class practice
- want more professional development (STEM and pedagogy)

³ Washington University's Education Department was the higher education partner on the proposal, but both key staff left the University in the summer of 2007. As they had no appropriate staff in place to assume the needed roles, the university withdrew from LIONS.

Thus, while the teachers are generally far from the “science leaders” envisioned in the original proposal, most are exhibiting progress in their professional growth as a result of their participation in the program. A focus in the more formal analysis of the interview data will be to disaggregate which teachers are experiencing the greatest success and what school and teacher factors promote or inhibit successful program operations.

Next Steps

A four-part program support model is being initiated for the 2008-2009 school year, designed to address teachers’ expressed interests and needs (informally shared and documented in the evaluation instruments described above). These elements, with the supporting rationale are:

Participation in the Bird Sleuth program offered by the Cornell Lab of Ornithology.

Journey North has proven to be a solid anchor for the less confident teachers for the past two years. It is time to move on, both to ensure variety in the program offerings and to advance the level of inquiry students engage in. Bird Sleuths, the latest iteration of Cornell’s highly successful citizen science projects, supports students’ investigation of bird populations in their community. Data collected from these investigations are submitted to Cornell’s central database of bird sightings, and students use this larger data to place their observations in a larger context.

Extend the depth of service learning opportunities. Several LIONS groups engaged in moderate service learning projects, including collection of prairie seeds to assist in native plant restoration (linked to their study of Monarch butterfly migration), planting tulips for beautification at school sites (linked to their tulip study), and setting up and maintaining a geocache for a local environmental center (extending students’ use of GPS units in a summer project). Other schools were unable to establish a project due to time constraints or a misunderstanding of how service learning differs from community service. In the latter cases, typical projects included things like collecting recyclables for the school – useful activities, but not linked to any learning goals.

All teachers have been trained in the use of a service learning model by staff of the Jane Goodall Institute, but in most cases implementation wasn’t at the level and depth that LIONS staff and teachers had hoped for. In the coming year, a collective effort will be made to deepen the service learning opportunities and more closely align them with the Jane Goodall Institute model and the best practices articulated by the National Youth Leadership Council (cite).

Implement a student assessment program. To date, the evaluation tools discussed above have sought to capture student’s affective responses to the program. Examples of data collected in this process include interest in science careers, out of school choices in reading material and television watching, and students’ overall level of interest in science careers and community engagement. In the coming year, these efforts will be supplemented with a focused effort to capture students’ academic growth in STEM concepts. Teachers will be trained in use concept mapping to document growth in students’ understanding during specific units.

Develop a joint community-based project. Many teachers expressed a desire for support in developing original curriculum and in deepening their understanding of general science concepts. These interests are not able to be acted upon, however, given the high demands on their time as classroom teachers. In short, while they are interested, most teachers have been unable to arrange their schedules to attend planning meetings or professional development during the school year.

To address these challenges, LIONS staff and teachers will collaborate on the development of a joint investigation of how University City has changed over time – socially and ecologically. Teachers and students will use historic data and aerial photographs dating back to the 1930’s to

investigate and document continuity and change. By modeling curriculum design and anchoring the project in a mix of science and social studies concepts, teachers are expected to gain confidence in their ability to think about students' learning beyond professionally designed curriculum projects.

References

- Lave, J. (1988). *Cognition in Practice*. Cambridge: Cambridge University Press.
- National Youth Leadership Council (2008). *K-12 Service Learning Standards for Quality Practice*. Available at: www.nylc.org/objects/publications/StandardsDoc0508.pdf
- PEEC (2008). *The Benefits of Place-based Education*. Place-based Education Evaluation Collaborative. Available at: www.litzsinger.org/peecweb.pdf.
- Roth, W and Barton, A.C. (2004). *Rethinking Scientific Literacy*. New York: RoutledgeFalmer.
- Sobel, D. (2004). *Place-Based Education: Connecting Classrooms and Communities*. Great Barrington, RI: The Orion Society.
- Sobel, D. (2008) *Childhood and Nature: Design Principles for Educators*. Portland, ME: Stenhouse.

The Equations math game is available at www.wffnproof.com/store/. Rules used by LIONS students are available at www.giftedresourcecouncil.org/pdfs/Rules08.pdf