INTEGRATED GEOSPATIAL EDUCATION AND TECHNOLOGY TRAINING

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ABSTRACT

An educated and technologically skilled workforce is essential for successfully moving land imaging from experimental to operational status. This paper will describe how the National Science Foundation funded project, "Integrated Geospatial Education and Technology Training (iGETT)," (NSF ATE DUE #0703185), is addressing the issue by working with two year college faculty. The paper will share highlights and lessons learned from the first 18 months of the three-year project, and begin to suggest next steps for building upon this important effort.

Although the increasing accessibility of remote sensing data and software has made it easier for people to learn about remote sensing, educated faculty and coursework that integrates remote sensing with other geospatial technologies have been lacking. iGETT enables faculty who are already teaching Geographic Information Systems (GIS) to integrate land remote sensing data and Global Positioning Systems (GPS) into their programs. 40 college faculty from across the United States are receiving education in the fundamentals of land remote sensing, where and how to get federal land remote sensing data, and how to integrate it with GIS and GPS to address workforce needs in agriculture, disaster management, and environmental sciences. Each iGETT participant develops a Learning Unit that covers at least two weeks of class time and is freely available to other educators. iGETT participants also receive free GIS and remote sensing software, as well as education and funding for program marketing and outreach, regionally and nationally. The National Council for Geographic Education; Del Mar College; ESRI; NASA's Landsat education staff; and the U.S. Geological Survey Land Remote Sensing Program are partners in iGETT.

INTRODUCTION

A successful national land imaging program requires a geospatially literate and educated workforce. The use of land remote sensing, integrated with other geospatial technologies, offers powerful and versatile means of assessing conditions and solving practical problems in a multitude of domains at local, regional, and global scales. Advances in software, hardware, data acquisition, and data sharing have opened the doors to these technologies for non-experts in a wide range of workforce domains that rely on geospatial data. Private industry and government agencies have created invaluable archives of remote sensing data and software for data analysis, and they continue to do so with increasing sophistication. The demand for educated employees is growing. With such a bright geospatial future, few obstacles should remain in the way of geospatial workforce development to meet a national need.

The reality is that the availability of both coursework in geospatial technology and trained faculty who can teach it has not kept pace with the dramatically developing opportunity. Many two-year colleges have developed GIS programs to meet the needs of both traditional students and technicians who are already in the workforce. Approximately 1,200 regionally accredited community colleges in the United States serve more than 11 million students, approximately 46 percent of all U.S. undergraduates. Of these colleges, 400 offer courses in GIS, but very few offer programs in remote sensing. Few instructors have educational backgrounds in remote sensing.

Figure 1. iGETT staff and participants at Del Mar College, Corpus Christi, TX, where Summer Institutes take place.

BEGINNINGS

In 2005 the remote sensing and GIS educators and scientists who are now the Principal Investigator and Co-Principal Investigators of iGETT discovered shared interests and questions about geospatial workforce development. With the knowledge that some educators were teaching the fundamentals of remote sensing to middle and high school students and teachers, that remote sensing was taught at upper levels of four-year colleges, and that GIS had a significant presence at two-year colleges, the iGETT co-Is began to consider how well-positioned the two-year colleges might be to play a role by integrating remote sensing with GIS for workforce development. Would graduates of two-year programs be attractive as prospective employees to industries that use geospatial technologies?

Two-year colleges have many strengths as sites for workforce development. Students and members of the workforce already look to two-year colleges for technical education. Two-year colleges are conveniently located for many people who have limited mobility because of full-time jobs, and many of these colleges have good connections with prospective employers. The large proportion of minority students and other underserved populations in two-year colleges also means these schools have the potential to contribute much needed diversity to the geospatial workforce. However, most faculty have not had educational backgrounds in remote sensing, and with heavy teaching loads and the absence of other faculty nearby who share their interests in geospatial technologies, they find it difficult to explore a new discipline.

Discussions about these issues and opportunities stimulated a immediate interest across the country and led to an exploratory two-day workshop, *Integrating Geographic Information Systems and Remote Sensing for Technical Workforce Training at Two-Year Colleges*, at the National Science Foundation in August 2005. Experts gathered from the remote sensing industry; federal, state, and county government; two-year and four-year colleges; professional societies and national associations, and NSF's Advanced Technological Education Program (ATE). The workshop was sponsored by NSF ATE, ESRI, NASA, and the U.S. Geological Survey. The organizing team worked closely with the American Society for Photogrammetry and Remote Sensing (ASPRS) and with the American Association for Community Colleges (AACC), both of which have strong interests in two-year college geospatial education.

Workshop participants explored five sets of questions:

- Is there a demand for geospatial technologists with two-year training?
- What kinds of geospatial education programs are currently in place at two-year colleges? What educational and professional support is available for two-year programs?

- What education programs and learning resources should be in place at two-year colleges in order to meet geospatial workforce needs?
- What challenges and obstacles must be addressed in order to implement ideal programs?
- What recommendations can be made for implementation strategies?

Participants reached agreement that two-year colleges can assume an important role in addressing geospatial workforce needs. A full report on the 2005 workshop can be downloaded from the iGETT Web site; Resources section: http://igett.delmar.edu/ Key recommendations dealt with faculty education, curriculum, funding and enrollments and administrative and faculty support. The lack of qualified faculty and curriculum were identified as critical issues. Employers at the workshop expressed interest in applicants who not only could integrate geospatial data from different sources to solve practical problems, but who also could communicate about the work.

Based on the results and recommendations of this workshop, the organizers proposed a three-year faculty development program to NSF ATE, "Integrated Geospatial Education and Technology Training (iGETT)." iGETT was funded for the period June 2007–May 2010.

As of the date of this publication, the iGETT program is in its second year of the three year period. The bulk of participant education has been accomplished, while some teaching and mentoring are ongoing. Participants are working on specific products and outreach activities described below.

PARTICIPANTS AND STAFF

iGETT's strength comes from the commitment and dedication of both participants and staff. Everyone involved shares a passion for learning and teaching the use of geospatial technologies for problem solving to benefit local communities and society at large.

iGETT investigators are all senior educators with experience in teaching, workshop design and implementation, and geospatial technologies. They have came to the project with different strengths: geography education, GIS training and program marketing, remote sensing education, remote sensing data analysis, and land remote sensing data acquisition and archiving. Osa Brand, Education Outreach Director for the National Council for Geographic Education, is Principal Investigator. Co-Principal Investigators are Jeannie Allen, SSAI at NASA Goddard Space Flight Center; Phillip Davis, Professor of Computer Science at Del Mar College; Rachel Headley, Data Acquisition Manager, Acting; Landsat Project, USGS EROS; and Ann Johnson, Higher Education Solutions Manager for ESRI. Co-PIs had not worked together before organizing the 2005 workshop at NSF. Observing each others' high levels of commitment, dedication, and professional skills in 2005 built a sense of trust and respect that molded a solid foundation for iGETT, the larger and later project.

iGETT's 40 participants have come from a pool of applicants across the country. They have been drawn from several disciplines, but have had in common a strong background in GIS. In addition to the application, each applicant submitted a letter from a department chair or college administrator, agreeing to cover transportation costs to the two Summer Institutes in Corpus Christi, TX, and to support program innovations based on iGETT participation. In that way, iGETT staff received written assurance that each participant's college administration was informed and supportive of the project. All applicants were required to have access to computer laboratories that could support GIS and remote sensing instruction.

Some concern had been expressed that iGETT would not attract enough applicants, but with only a one-month window of time for prospective participants to apply, more than twice as many applications were submitted as could be accepted for the first group of 20 participants. About the same number of applications were submitted for Cohort 2. Applications were evaluated according to the potential impact on courses and programs at the participating institutions. Selections were also guided by the goal of broad geographic participation and strong representation by institutions with underserved populations.

Thirty-seven of the 40 participants in iGETT are college Instructors, and four of those teach at Tribal colleges. Three of the 40 participants teach high school. Cohort 1 joined the project in July 2007 and will participate until June 2009. Cohort 2 joined in June 2008 and will participate until June 2010.

Figure 2. Participants' differing areas of expertise, together with nearly a week of work time during the two-week Summer Institutes, has led to collaboration and to strong relationships among geospatial education professionals who live and work far apart. "You have given us a community we didn't have before," said Mike Rudibaugh, Lake Land Community College.

Participants have recognized iGETT as an unusual opportunity for them and have repeatedly expressed appreciation for the program throughout their experience. Nearly all participants are the only individuals at their institutions teaching geospatial technology, and therefore generally have not had many opportunities to share geospatial technology education interests and problems. iGETT Institutes provided participants with new colleagues across the country, as well as valuable experiences and resources they had never had and lacked the means to acquire.

Participants' levels of intention to take advantage of working as a community through iGETT have been high. Together with the staff's dedication and attention to detail, their commitment created an atmosphere of productive collegiality. Marguerite Madden, ASPRS President in 2007-08, visited both groups of iGETT participants during the Summer Institutes. She commented on the quality of participants in April 2008: "After being there for only a few hours last year, I clearly recognized the high level of motivation, enthusiasm and intellectual curiosity of this group."

Commitment and dedication have been required, because the work has been challenging. It is not easy to bring the technologies and cultures of different disciplines together. Participants have come to the program with different levels of experience, and this has been a particular struggle for those with the least experience. At the same time, everyone involved has realized that iGETT is a pioneering effort, and sharing the struggle has helped to strengthen the community.

Several organizations have provided generous in-kind support. ESRI, ITT Visual Information Solutions, and Leica-Geosystems have donated hundreds of thousands of dollars of software to the participants. NASA and USGS have sent scientists and data access experts from distant regions of the country to speak at both cohorts' Summer Institutes in Corpus Christi, TX. All five organizations represented by the PI and Co-PIs have allowed their employees the time needed to attend to the multitude of details required to achieve program excellence.

PROGRAM DESIGN

Participant Experience

Participants spend two and a half years with iGETT, including a total of three weeks of Summer Institutes; monthly seminars during the academic years; development of Learning Units; and activities to market integrated geospatial technology education programs at their home institutions. More detailed information about iGETT participant experience follows.

- Pre-Institute completion of a six-module GIS course or testing out of the course
  This requirement ensured that everyone's skills have been sufficient to benefit from the Institutes and to carry out their projects during the academic years.

- Two-Week Summer Institute during first year of participation, at Del Mar College, Corpus Christi, TX (Completed by Cohort 1 in August 2007 and by Cohort 2 in June 2008)
  These institutes included presentations by scientists using remote sensing in various practical ways; short lectures on scientific concepts, software technology, and access to Landsat, MODIS, and ASTER data; demonstrations and tutorials using the technology; hands on activities in the lab (downloading, carrying out analysis, etc); and free work time to carry out research on developing individual projects and Learning Units. During work time, remote sensing experts circulated among participants to provide one-on-one mentoring.

  Participants worked with data from Landsat, MODIS, and ASTER.

  One day of each two-week Institute was spent on a field trip to Padre Islands National Seashore, where participants learned how to ground truth their satellite data using GPS and ground-based spectral data. They completed a transect of vegetation to identify land cover.


Figure 3. Learning to use a Global Positioning System instrument and to complete a transect of vegetation at Padre Islands National Seashore helped iGETT participants to integrate their field and computer laboratory experiences and to appreciate the role of ground truthing in satellite remote sensing.

- Successful completion of an online course in remote sensing during the academic year in Year One.
  Cohort 1 participants selected one course from among several courses offered by the University of Mississippi, Institute for Advanced Education in Geospatial Sciences:
  http://geoworkforce.olemiss.edu/

  Most participants in Cohort 1 reported that some of the IAEGS material was irrelevant to their teaching. Most Cohort 2 participants took an alternative course, the Canada Centre for Remote Sensing tutorial, Fundamentals of Remote Sensing:=, at:
  www.**ccrs**.nrcan.gc.ca/resource/tutor/fundam/index_e.php

  Some Cohort 2 participants are taking both the CCRS tutorial and IAEGS courses.
- One-Week Summer Institute during second year of participation, at Del Mar College, Corpus Christi, TX (Completed by Cohort 1 in 2008, to be completed by Cohort 2 in 2009)

  The one-week Institute focuses on program marketing and development. Participants learn about grant writing; articulation agreements with high schools; engaging administration and faculty; recruiting students; building a Board of Advisors; and program development resources available from NSF's Advanced Technological Education Program.
- Monthly Web-based seminars (Webinars) during two academic years

  Webinars deal with participants' news, accomplishments, struggles, questions and concerns; updates on software; mini-tutorials; and networking in general to address a wide range of issues.
- Development of an educational module (Learning Unit) in which students integrate data from remote sensing, GIS, and GPS to solve a problem of concern to the local workforce (See "Learning Units," below.)

  The development of the Learning Unit is the crucible of participant education in iGETT, and the collection of Learning Units serves as a major contribution to the wider two-year college teaching and learning community.

- Development and implementation of regional outreach initiatives to market integrated geospatial education programs

  Through these initiatives, participants recruit students; disseminate information about the program to other two-year colleges; explore articulation possibilities with high schools and four-year colleges; and establish relationships with industries and government agencies that may need education for employees and/or be able to provide internships for students and jobs for graduates.

Learning Units

Each iGETT participant develops a Learning Unit to cover at least two weeks of class time. In the course of each Learning Unit, students obtain land remote sensing data (Landsat, MODIS, and/or ASTER data) and integrate it with GIS and GPS to address an issue of concern to the local workforce. Participants (authors) have chosen topics for their Learning Units from the three broad fields of agriculture, disaster management, environmental sciences. Please see Table 1 provides a list of Learning Unit titles under development.

Developing Learning Units is a primary accomplishment of iGETT participants and of the project. A major goal of the iGETT grant is to provide resources that will facilitate course enhancement and program development, not only at participants' home institutions, but also at other two-year colleges across the country. The bank of remote sensing-based Learning Units developed by participants, the Summer Institute education materials, and numerous other directly relevant resources will be available on the iGETT Web site (http://igett.delmar.edu) to all interested faculty for at least five years.

iGETT Learning Units follow a specific format. Each Learning Unit consists of three documents: a Curriculum Support Document, an Instructor Guide, and a Student Guide. Very specific guidelines, including titles for all sections in each of the three documents, were provided to Learning Unit authors. The information in the Curriculum Support Document helps other educators wishing to adopt or adapt the Learning Unit by providing specific details usually required by colleges when adding, modifying or updating programs at two year colleges. The Instructor Guide provides educators with all the instructional details, basic concepts (or references to where one can learn basic concepts), and background information for the focus topic, and all other resources necessary to teach the Learning Unit successfully. The Student Guide provides background on the topic content, step-by-step instructions, and all data and other resources needed to complete the Learning Unit.

iGETT Learning Unit authors are also required to produce a one-slide PowerPoint (PPT) presentation that described their Learning Unit, using a template provided by staff. The collection of all such PPT presentations will provide a source of quick information for non-iGETT educators interested in learning what Learning Units might be available for their own use with students.

In the process of development, Learning Units are reviewed by remote sensing, GIS, and education experts on the iGETT staff. Completed Learning Units are field tested by their authors and other instructors. ASPRS has agreed that its members will review Learning Units for their relevance to workforce issues. An editor who is expert in both remote sensing and GIS will provide coherence and polish to the writing in the Learning Unit collection.

Table 1. iGETT Learning Unit Titles and Authors by State

State	Learning Unit Title	Author	College
AZ	Quantifying Areas in Cultivation in Maricopa County	Remy Autz	Phoenix College
AZ	Measuring Land Use and Land Cover Change	Luis Bleuze	Genesis Academy
AZ	Measuring Hydrological Inputs from Snowpack	Karen Blevins	Mesa Community College
AZ	Land Cover Change in Phoenix, Arizona	Sian Proctor	South Mountain Community College
CA	Land Use Change from Agriculture to Urban in the Santa Clara Valley of California	Christopher Cruz	West Valley College
CA	Burn Severity and Post-fire Chaparral Recovery	Vicki Drake	Santa Monica College
CA	Land Use/Land Cover Change in the San Fernando Valley: Risk Assessment	Gail Hobbs	Pierce College
CA	Redding Land Cover/Land Use Change	Dan Scollon	Shasta College
CA	Introductory Remote Sensing Image Analysis	Adrian Youhanna	Pierce College
IL	Growing Season Analysis of NDVI Values for Agricultural Land Use in East-Central Illinois	Mike Rudibaugh	Lake Land College
IA	Identification of Biomass Resources Using Remotely Sensed Data for Localized Ethanol Production	Terry Brase	Kirkwood Community College
IA	A Comparison of Iowa June 2008 Flood to the 100-year and 500-year FEMA Flood Maps, Using Landsat	Gail Brown	Kirkwood Community College
ME	Land Cover Change in Maine	Scott Hood	Kennebeck Valley Community College
ME	Detecting Change in Land or Snow and Ice Cover Over Time	Tora Johnson	University of Maine at Machias
MI	Urban Growth in West Michigan	Diana Casey	Muskegon Community College
MN	Utilizing Continuous Fields to Monitor Land Use Change in the St. Louis River Watershed	Elizabeth Sedgwick	Fond du Lac Tribal and Community College
MS	Determining the Effectiveness of Landsat for Identifying Forest Regeneration in Southeast Mississippi	Sean Hodges	Mississippi Gulf Coast Community College
MS	Tri-County Economic Loss Due to Ross Barnett Reservoir Dam Failure	Tony Howard	Hinds Community College
MT	Delineation of Mountain Sheep, *Ovis canadensis*, Habitat in the Bear's Paw Mountains of Rocky Boy Reservation	Douglas Crebs	Stone Child College
MT	Identifying Bark Beetle Outbreaks	Robert Kenning	Salish Kootenai College
NM	Evaluating Forest Tree Die-off and Fire Hazard	Amy Ballard	Central New Mexico Community College
NC	Land Use Change in Adjacent Basins of the Catawba River Watershed and Its Impact on Water Quality	Rodney Jackson	Central Piedmont Community College
NC	Using Land Cover in the Catawba River Watershed to Predict Stream Water Quality in Mecklenburg County	Reed Perkins	Queen's University of Charlotte
ND	Unsupervised Landsat Classification of Soils for Agricultural Land Parcel Tax Valuation	Angie Milakovic	Bismarck State College
ND	Williston's Dam Conundrum: Risk Assessment	Jacquelin Stenehjem	Bismarck State College
NY	The Potential of Greenway Development along the Niagara Escarpment	Robert Lord	Niagara County Community College
OR	Addressing Food Insecurity with Rooftop Gardens	Lynn Songer	Lane Community College
TX	Flood Risk Assessment	Barbara DuFrain	Del Mar College
TX	Introduction to Qualitative and Quantitative Land	John J. Nelson	Del Mar College

	Cover Change		
TX	Urban Heat Island Characterization with Thermal Remote Sensing Data	Peter Price	North Harris College
UT	Analyzing Rainfall and Vegetation Changes through Desertification Prior to Genocide in Darfur, Sudan	Adam Dastrup	Salt Lake Community College
VA	Does Your City Qualify for City Green?	Fred Hoffman	Roanoke Valley Governor's School for Science and Technology
VA	Urban Sprawl and Sediment Loading in Chesapeake Bay	Mike Krimmer	Northern Virginia Community College
VA	Gypsy Moth Defoliation	David Webb	Virginia Western Community College
WA	Land Use Change in Snohomash County	Kerry Lyste	Everett Community College
WI	Forest Classification	Dawn White	Lac Courte Oreilles Ojibwa Community College
WY	Land Surface Heat Emissivity in Yellowstone National Park	Trent Morrell	Laramie County Community College
WY	Assessing Areas of Suitable Grazing Land for Rangeland Cattle	Jeff Sun	Casper Community College

Deliverables and Due Dates

A schedule of Deliverables and Due Dates was provided during the two-week Summer Institute in Year One, so there would be no lack of clarity about what was expected of participants. Stipend payments have been tied to participant submission of deliverables.

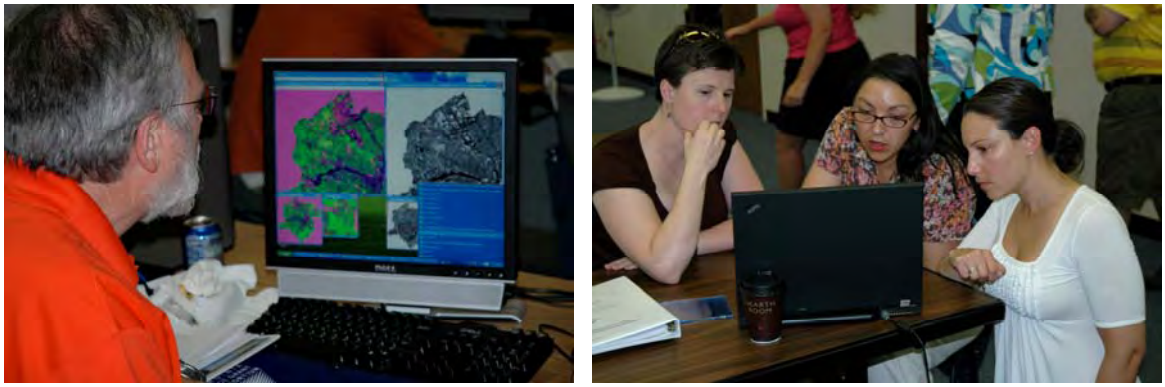

Figure 4. Learning to download and analyze Landsat, MODIS, and ASTER data using ENVI is fundamental to iGETT. "I had been aware of Landsat, but never quite knew how to work with it," said one participant.

Stipends

iGETT participants receive stipends to help defray expenses or lost income while attending the Summer Institutes. They also receive reimbursement of up to $500 for regional travel to disseminate information about program innovations, recruit students, develop relationships with industry and government agencies, and conduct other outreach activities In addition, all participants may compete for six travel awards of up to $1,300 to make presentations about their program innovations at national professional conferences.

RESULTS

Evaluation

SCATE Inc., in collaboration with South Carolina Advanced Technological Education Center of Excellence and National Resource Center for Engineering Technology Education, is serving as external evaluator of iGETT. The

evaluators conduct formative and summative evaluation using a mixed-method design to include both qualitative and quantitative methods. Pre- and post-Summer Institute surveys, on-site visits at Summer Institutes, personal interviews with participants and staff, e-mail exchanges, and observations of monthly Web-based seminars for participants are components of the approach. Yearly reports are submitted to NSF ATE.

The external evaluators' Year One report summarized the evaluation in this way: "As the iGETT project completes the first year of activity, impact is already evident. Participants are fully engaged, and the project team is providing frequent support as instructors master new skills and prepare to teach the skills to their students. Project activities are creating and nurturing a mutually supportive learning community that holds promise for sustainability long beyond the life of this project. This is an intense faculty development project that requires a substantial time commitment from every participant. Retention of 100% of cohort 1 participants through the first year of this development process is perhaps the most significant early indicator of success for this well organized, managed, and conducted project. The PI and her team are doing an outstanding job."

Participant Products and Activities

Of the 20 Cohort 1 participants, 17 have submitted first drafts of their Learning Units and at least one more draft is expected. Those Learning Units will undergo field testing this year, and will be professionally edited. Of the 20 Cohort 2 participants, 20 have submitted Learning Unit proposals, and all have been accepted. In June 2008, Cohort 2 will present their Learning Unit first drafts to one another and submit them to iGETT PI and Co-PIs. Those Units will be field tested and edited for posting on the iGETT Web site.

Cohort 1 participants have already conducted about 75 outreach events, such as seminars for faculty or for local government groups, workshops for students, career focus events, and other presentations. It should be noted that outreach activities were not expected of participants, and no funding for outreach was provided until Year Two of their experience, so these activities can be seen as reflections of participants' enthusiasm. Two Cohort 1 participants, Chris Cruz and Dan Scollon, wrote a successful a California Workforce Initiative grant, "CalGETT," to accomplish on a regional scale what iGETT is accomplishing on a national scale. CalGETT focuses on land management and partners with the U.S. National Park Service.

Other Education Resources

All resources used during the Summer Institutes are online at iGETT's Web site. The site is being redesigned as this paper goes to press, and will be operational before October 25.

LESSONS LEARNED

Lessons learned from development and implementation of the first two years of iGETT deal with staff; design of the Summer Institutes; ways to build community among participants; and facilities and materials.

Staff

- Developing and implementing a relatively small project, the two-day workshop at NSF in 2005 proved to be an excellent testing ground for compatibility, productivity, and collegiality as a staff on the larger project, iGETT.
- Having one staff member dedicated to financial oversight was beneficial. Such a staffer can smooth the process of paying bills and getting supplies as needed.

Institute Design

- Providing participants with time away from home and office, apart from all other responsibilities, enabled them to focus, to become completely integrated with the learning community, and to accomplish a great deal more on their Learning Units than they might have otherwise.

Figure 5. iGETT staff held multi-day planning meetings before each Summer Institute. At right above, Elaine Craft, South Carolina Advanced Technological Education Center of Excellence, who served on the iGETT external evaluation team, works with Tora Johnson, University of Maine at Machias.

- The two-week duration of the Summer Institutes in the first year of each cohort's experience was a critical component of participant achievement. It allowed for several days of guided but unstructured time for participants to absorb and integrate the new ideas and skills they were learning with their existing knowledge and skills, and to work on their Learning Units. During this work time they received one-on-one tutoring on the technical aspects of their Learning Units. "Developing the Learning Unit was the most effective part of the Institute. There's no other way to learn it than to do it," reported one participant. "Everything…was valuable…no time was wasted," reported another participant.
- The intentional overlap of Cohort 1 and Cohort 2 that occurred for four days during the Summer Institutes in 2008 allowed the members of Cohort 1 to share what they had accomplished over the preceding year with Cohort 2. It helped Cohort 1 by forcing them to focus on their Learning Unit deliverables, and it helped Cohort 2 by providing examples of successful Learning Units. At a broader level, it made community building possible among all participants in the project.
- During Year One, the two-week Summer Institute was held in August. During Year Two, the two-week Summer Institute was held in June. Holding the Institute in June (Cohort 2) was preferable, because Cohort 2 had most of the summer to work on their Learning Units, whereas Cohort 1 had to prepare for the upcoming teaching semester shortly after the close of their Institute.
- Requiring some pre-Institute review of an introductory level of the new technology to be learned benefits participants by getting them up to same level of expertise.
- An introductory level of education was beneficial, even for participants with experience in remote sensing. Many participants appreciated review of high school level materials on remote sensing.
- Having specific deliverables and a time line to complete those due during the Institute was essential
- A general approach to teaching technology that worked well was to alternate participant listening time with active time, in units of about one and a half hours each, with mid-morning and mid-afternoon breaks.
- The approach to training technology, whether remote sensing, GIS, or GPS, that participants favored was for the trainer to first give a demonstration of a relatively short part of the material with participants simply observing, not working on their computers. The trainer would then allow time for participants to work through the exercise self-paced, with step-by-step illustrated instructions to follow and technical mentors circulating to give one-on-one help as needed.
- Tutorials including screen captures were extremely helpful. Text alone was not sufficient for a good comfort level in learning the technology.
- The ratio of remote sensing experts to participants was 2:20. Given they were dealing with almost entirely new material; it would have been preferable to have a ration of at least 3:20.

- Outside speakers on the practical applications of integrated geospatial technologies were a highlight of the Institute, bringing high levels of professional expertise and fresh perspectives to participants. Such presenters should limit their remarks to 45 minutes.
- Because feedback from Cohort 1 on their Year One Summer Institute reflected interest in having science sessions and technical sessions interspersed, i.e. not having all science presentations on one day and all technical session on the next, staff re-designed the Year Two Institute the preferred way. Cohort 2 complained of some confusion about where they were in the agenda from time to time. An Institute agenda flow chart that showed exactly where the group was in the agenda, and the nature of each session's relationship to the rest of the workshop would have been helpful.
- Daily feedback forms administered at the end of each day, reviewed by staff at night, and addressed at the beginning of the first session on each following day allowed the staff to shape the Institute to meet specific participant needs. It built participant trust in staff and sense of ownership in their own learning experiences.
- Attention to detail in planning and implementing a project such as iGETT makes a difference that should not be underestimated. Participants' levels of confidence in the staff, and their ability to relax and focus on the very demanding learning and Learning Unit development that are required of them, have been enabled to no small extent by staff assiduous attention to detail throughout the Institutes.

Building Community

- Prior to the beginning of each cohort's first Institutes, a "face book" consisting of color photographs and one-paragraph self-descriptions submitted by each participant was distributed to each participant. It helped participants to feel familiar and comfortable with each other and to bond more quickly. Because of the face book, some participants recognized each other at airport hubs on their way to Corpus Christi for the first Summer Institute, and completed their trips together.
- Cohorts 1 and Cohort 2 overlapped for four days during the Summer Institutes in 2008. That time together predictably contributed enormously to community building among all participants. Not only did the two cohorts spend nearly two program days together, but they also spent social time before and after the hours of iGETT programming everyday.
- Participants' social time was enabled largely by housing in the same hotel, where most participants occupied suites in which each person had her/his own bedroom and shared a living room/kitchen. Del Mar College staff also provided a wealth of information about local events each evening, and even provided vehicles for transportation to those events. (Friends of Del Mar staff took some participants sailing on numerous occasions.
- An unexpected outcome of participants completing daily feedback forms and staff responding to that feedback as the first order of business each day was that participants learned what the others were thinking and feeling about the Institute experience itself, and reported to staff that it helped to build community.

Facilities and Materials

- Binders with printed learning materials and annotated lists of related resources were distributed to participants at the beginning of each Institute. Participants were required to organize and populate their binders themselves, which meant they reviewed contents with more attention than if staff had completely compiled the binders.
- It should not go without saying that these facilities are required for a successful training institute: adequate computer access, sufficient network access, lighting that can be adjusted, heat/cooling that can be adjusted, supportive, comfortable chairs, desk space with enough space for both textbooks and hand-writing, a color printer, a white board, small note paper, and poster paper for a variety of purposes.
- Morning and afternoon beverages and snacks provided indispensable refreshment to participants and staff.

NEXT STEPS

iGETT is spearheading the integration of land remote sensing into the geospatial education community and helping our nation build a geospatially-prepared workforce. But for participating college instructors to learn a new technology and become experienced enough to teach it requires a sustained effort over several years. Participants continue to express enthusiasm and commitment to the effort, and to communicate their strong wishes to gather again as a newly formed community. In addition, many other college faculty have expressed keen interest in this

kind of education.

Faculty professional development, community building, and experience in using remote sensing together with other geospatial technologies are the threads that should continue beyond iGETT. How can the effort be extended and expanded? Conversations among iGETT staff and participants are continuing as the project matures. Some ideas have included extending iGETT to reach a third cohort; regional workshops that would be based on specific focus topics important to each region's economy; and mentoring by federal geospatial technology professionals.

Federal agencies engaged in land remote sensing data acquisition and archiving, such as NASA, USGS, and NOAA, can benefit from a geospatially skilled workforce. Geospatial professionals in these agencies and in private industry might explore support of workforce development by engaging discussion with education professionals. They might consider becoming mentors to two-year college faculty on the basis of shared research interests; becoming actively involved in team-teaching at two-year colleges; and by hosting student interns.

In June 2008, NSF funded a National Geospatial Technology Center of Excellence, led by iGETT Co-PI Phillip Davis at Del Mar College. The NGTC can serve as a hub and partner for future activities to integrate land remote sensing with other geospatial technologies.

ROBERT C. LORD

On August 30, 2008, one of iGETT's exemplary participants and a leader in the National Geospatial Technology Center, Robert C. Lord, passed away. This paper is dedicated to Rob, a consummate geographer, teacher, and friend, whose spirited intellect, humor, and passion for geography education will long be remembered.