Abstract

Professional development opportunities for educators emanating from the SCI-LINK project are described over a twenty-five year period of time. Development and methodologies leading toward changes in individual and group educational practice and leadership skills are detailed. This framework is examined in three different and unique programs focused on the environment, teaching and learning techniques, social group work practices, and dissemination of information. The growing importance of global thinking is highlighted. Networking and connections, linking scientists and experts to practitioners, cooperative input of many individuals toward the teaching and learning goals – all lead toward an enduring network of individuals.

Programs examined involve twelve years of a one-day experience focused on an environmental topic; eighteen years of a one-week residential experience in a specific ecosystem; and five years of a two-week ecology and education travel experience and seminar in a foreign country.

It is of vital importance that outcomes of professional development experiences such as these are evaluated over a long time frame.

Introduction

For over 25 years, Stubbs' work has focused on professional development opportunities for educators. Several major projects were supported by the National Science
Foundation: SCI-LINK began in 1991 and GLOBE-NET began in 1992, both continuing until 1996. The SCI-LINK project linked current environmental scientific research with scientists, teachers and students; the GLOBE-NET project supported the development and publishing of instructional materials representing global environmental change. In this paper, we discuss three different scenarios, all with common elements that were part of these projects or are outgrowths of what we learned in these years (Progress Report to the National Science Foundation 1996).

A specific framework that exemplifies successful strategies and methodologies for teaching and learning were presented in one-day, two-day, one week, and two week sessions. Common elements throughout these workshops include: an environmental focus, social group work practices and techniques, scientists and experts presenting information, incorporation of the culture of the local community, challenges for participants as groups and as individuals, the selection of participants representing different vocations and different locations, use of technology, and the development of an activity/presentation/curricula by each participant to be used in his/her home settings. Initially science teachers were targeted, but, (by request) the audience rapidly expanded to include teachers of every discipline and every age group, from K-16 to adults, to those employed as environmental educators, extension agents, administrators, and others in various non-governmental organizations (NGO’s), local and state agencies, universities and schools. In the last few years, participants also come from business.

A key aspect of the course design is to draw upon numerous connections, cooperators and collaborators. Sharing and communicating, developing ongoing networks and forming an expanding and lasting ‘esprit de corps' are essential components. These components nurture inspiration, new ideas, and expand the mind. Our objective has always been, and continues to be, to enable "preK-16-adult" teachers to "be the very best that they can be," to provide quality education for their students, spilling over to co-workers, parents, and community.

Teachers have always been involved in every stage of planning, whether it is a publication, selection of a topic for a workshop, or the final product of the workshop. The Teacher Committee has been an essential component for the project’s positive outcome. Scientists (for example, Cunningham et al, 2007) and experts contribute to our subject matter - another important component of our work and its results.

An overall philosophy pervades all our work. We believe that:

• Teachers are interested in new ideas and information and want to take this new knowledge back to the classroom.

• Teachers are skilled professionals, trained in their science subject areas, competent in teaching, knowledgeable of their students and curricula, and are the best people to translate new ideas and knowledge into classroom practice (Howe and Stubbs, 1998).
This paper discusses three approaches that have been most successful. We are still learning, and we are still fine-tuning. But the model for each has been developed and tested over time and we are comfortable in sharing these findings with others. Through the years, we have provided many ‘workshop-experiences’ in each category. We are selecting one example of each to portray in this paper, providing the schedule, planning, and outcomes.

**Professional Development Model in Practice**

Three different programs have been in practice since 1988. Listed below are examples from each of the programs that will be elaborated upon. The first is a one-day ‘experience’ focused on a specific topic of interest chosen by teachers (Teacher Day: examples: GIS in Education; Ozone; Changes in the Environment). The second is a residential one-week workshop focused on an ecosystem in a specific place (Grandfather Mountain International Workshop). The third is a two-week international adventure in ecology and education with one week in a major metropolitan area and one week in a pristine environ to learn about education, environment (flora, fauna) and culture of that country (Brazil: Adventures in Ecology and Education).

In this paper, we will discuss:

1. How each of these three programs were developed and carried out;
2. How technology is embedded within the course experiences;
3. How a network of cooperators/partnerships/collaboration is established;
4. How science education, environmental education and other standards have been incorporated into each model;
5. Evaluation and feedback that further enhance the model.

One of the tenets on which these programs are built is described below:

“…the imagination is not only about creation; it is also about how we see and how we experience. We cannot create in a fresh and lively way while looking at our world from a stale (even if familiar and comforting) perspective. So, before the productive work of the imagination can begin, we must be outside of the familiar,” (White, 2004, p. 2).

**Teacher Day**

In 1991, SCI-LINK began a one-day symposium for teachers, featuring a current environmental science topic of concern. These symposia were purposely planned and held on a Friday before a weekend, in late January or early February, in the middle of the school year when both teachers and students needed a break. We believe it provided a “shot in the arm” during a down time of the year, weather-wise and school-wise. Teacher Day, held each year from 1991 - 2002 attracted educators from across North Carolina together with scientists, science educators, and government agency personnel for an extraordinary day of learning, networking and energizing. Teachers met and heard from leading scientists, who introduced current environmental research,
networked with educators from other schools, and brainstormed about how to take the new information back to their students. Teacher Day provided an exciting, stimulating professional development opportunity that generated renewed enthusiasm. It gave teachers an added boost for working with their students the remainder of the school year.

*Environmental topics selected by teachers for Teacher Day:*

In 1991, Climate Change was a most important topic, and a symposium on the topic, led by Governor James Hunt, was held by the Emerging Issues Forum at NC State University. We requested that a special teacher cohort be allowed to attend. Those participating in the forum ascertained that classroom teachers needed more knowledge to teach their students effectively about the subject. They requested a day of information specifically for educators. Consequently, our first Teacher Day focused on Climate Change! In the following years, other Teacher Day topics included: Reduce, Reuse, Recycle, or Waste Prevention, Ozone (Ground-level), Water, Global Change, Wetlands and Estuaries, Environmental Health, Geographic Information Systems (Stubbs, et. al., 2002), and in 2000: Changes in the Environment: Implications for the 21st Century. Many educators returned each year!

*Staging Teacher Day*

A successful day does not simply “happen”. It is vitally important to "positively stage" such an experience. Even the smallest detail is important, which we found were often overlooked in ordinary professional development experiences. We wanted to focus on educators, to be certain they knew we thought they were very important people. We wanted to support them and let them know they were doing a most important job! We held our Teacher Days at the conference center and at the faculty club at NCSU (teachers could become accustomed to the university setting when they returned for class work). The following items and activities contributed to making Teacher Day a positive experience for our teachers.

1. Hello! Glad you’re here! Master Teachers and office staff greeted participants as they arrived. Tables were manned by Master Teachers and office staff to quickly and conveniently register participants.
2. Name tags had the first name of the participant in a large font size, easy to see, and difficult to ignore. We tried many different types of nametags, and agreed we liked the ones that clip on. (These nametags were collected at the end of the day, to be used the following year, illustrating our ongoing recycling within the project).
3. Packets of resource materials, compiled and assembled by SCI-LINK/GLOBE-NET project staff and teachers, were provided to each participating teacher and included maps, booklets, background information, photographs, videos, websites, books, bibliographies, etc. These resource materials were donated by organizations, agencies, and NGO’s – all usable by educators in their classrooms, nature centers,
wherever they worked. We obtained special bags for the teachers to add to - sometimes from the NC State bookstore; sometimes a grocery store; sometimes a book company – all donations, indicative of the reuse, recycle focus.

4. Exhibits in an adjacent room offered demonstrations, specific handouts, curricula, and a chance to meet resource personnel in federal, state and local agencies, environmental science organizations, as well as publishers and producers of resource materials. Time to visit the exhibits was a must, and might be scheduled before the program began, during the break time, after lunch, or after the program was completed.

5. Breaks were carefully planned. Some breaks were the time for mixing and conversation. Or a short break might suffice, to simply stand up, turn around and talk with the person behind you. During a longer break, there might be assignments to complete within a group. A time limit was always established and a bell set. Different teachers were assigned (randomly) in each group to report back to the entire audience at a designated time.

6. Lunch

- Inspirational luncheon speaker selected by The Teacher Committee.
- Luncheon menu chosen by The Teacher Committee. These lunches were always filling and delicious, but were not the most expensive lunch on the menu. Vegetarian choice was available.
- Small round tables seating eight, enabled participants to talk with every person at the table. It is most important for each person to be able to interact with everyone. Many times, seating was arranged with nametags at each place, so educators would be purposely mixed, and friends did NOT sit together.
- Centerpieces. Sometimes, these were provided by students of Master Teachers, illustrating a particular point – i.e., recycling, invasive plants of an area, etc. Placemats were occasionally donated by students in the teachers’ classes.
- Problems to be solved during lunch. At times, each table was given a different question to discuss/ and or a problem to solve.

7. Prizes and Surprises. One year, prizes were given for the person who came from the farthest distance away. Or to the first person to arrive! Or, prizes might be given for those who had attended at least 7 of the Teacher Days. Special awards were given to those who held a leadership role. We tried to surprise participants, so no one ever knew precisely what to expect.

8. Activity development. Each participant developed an activity from an idea they gleaned from Teacher Day – to be taught in the educator’s home environment. This process is discussed by Anderson (1993a) in detail. Possibly the most important aspect is the immediate application of what has been learned. Participants wonder during the day what their activity will be and these ideas are honed during group discussions. Initially, the participant expresses critical uncertainty about the topic to be chosen, questions about how to develop an
activity, and finally, relief when all the pieces come together. The activity
development is a process all its own!

- 9. Advances in technology. When we first began, few teachers were using
computers and in fact, they were learning from their students! Stubbs states, "I'll
never forget the time when I had to show teachers how to turn on a computer –
they were really afraid of the machine! All 30 teachers were sitting before new
computers at a nearby university, not knowing how to use them!" Anderson
(1994) developed a booklet *Tips for Writing on the Computer* to help with the
transition. As time went on, teachers became more adept, and today, registration
by computer, submission of work electronically, communicating with one another
via Skype and other programs are the norm (Stubbs et al, 2003).

- **Developing “esprit de corps” Among Attendees**

  Every person is important! Everyone is accepted! To facilitate this idea, each
participant was asked to address everyone by first name. At the beginning of the
workshop, everyone was asked to introduce themselves quickly to the person
sitting on either side, behind, and in front. Many other techniques were employed
during all events. FUN is an essential component of all our programs!

  These one-day "seminars" were perfect for teachers as well as the experts. No
one had to travel far, since Raleigh is a midpoint in the state. An "esprit de corps"
developed among attendees. Scientists were introduced to teachers in "easy"
comfortable settings, where teachers could ask questions and become informed.
Then, teachers at a later time, felt comfortable asking a scientist to visit their
classroom to present information to their students. Anderson (1993b) developed
a booklet to support the experts/ speakers who had not presented before to
educators. This was unheard of at the time – but certain procedures and
methods were necessary in our early encounters with scientists who rarely
worked with teachers and/or their students. And, in this setting, scientists who
were not accustomed to working with educators could learn how to address
teachers in groups, to become aware of what teachers needed and wanted, and
be more comfortable in the broader educational environment which is quite
different from their research surroundings.

  A focus on a specific topic area, as selected by the Teacher Committee, was a
way to fill a need for educators who needed more information to effectively teach
their students - in the areas of science, mathematics, engineering and humanities
– and eventually, all subjects! We purposely asked experts of different
persuasions to present, thus providing more balanced views on any topic.

  Faculty and teachers from other states were invited to attend to provide different
perspectives. These invitees served as guest speakers, group leaders, and/or
facilitators of small groups. These teachers and faculty members would later
meet at state and national professional meetings.

- **Evaluation**

  Usually, in groups, participants reviewed the day’s program and discussed what
they would like as follow-up, how they would teach what they had learned, and
what information their students could use. Then, each completed an individual
evaluation – one page of open-ended questions - as they left the symposium and
in turn, picked up their information packet and Continuing Education Form (CEU).
Evaluations were tallied and submitted back to each teacher and sponsoring organization within two weeks. We would carefully review the evaluations afterward with the site manager, caterer and those connected with support activities. These evaluations were most important for review of staff members and for our future success with the Teacher Day programs.

- **Schedules**
  - Developing and following a workable schedule is critical for any professional development activity. Sometimes the details seem too trivial. Certainly details take an inordinate amount of time, but we have found attention to these details has "paid off." This process includes: develop goals and objectives of the day, then fill in the schedule and follow through with scientists/experts speakers, add teacher input throughout the day, include group work, individual work, a time to share and talk, evaluate, always closing on a positive note.

- A specific schedule, Teacher Day: Global Change (1995) has been included *(Appendix A)*, since this topic has received much publicity and attention recently (13 years later) (Stubbs & Anderson, 1995).

- Teacher Day was a successful, extraordinary day of learning, networking and energizing. Educators met and heard from leading scientists, caught up on current environmental research, networked with teachers from other schools, and brainstormed about how to take the new information back to their students. This Day provided an exciting, stimulating professional development opportunity that generated renewed enthusiasm for the remainder of the school year. Many teachers invited the experts to present current environmental research to their classrooms.

- **Barriers for this Type of Experience Arose Over Time**
  - Professional organizations within the state developed a stronger presence, providing much of the camaraderie opportunities for educators on a wider scale. Teachers could attain a position of leadership within the state, moving into the national scene. Many current topics are now addressed within the professional organization annual meetings, although the information is not as concentrated as what the Teacher Day provided. Many of the teachers within North Carolina became Board Certified Teachers (N.C. has the largest number of any state in the country), opening and broadening the educator's breadth of vision, knowledge of other teachers, and program possibilities. Many new teachers came into the state from other states and other countries with already established distant relationships.

- School budgets shrank. Gradually, teachers were required to pay for their own substitutes. Substitute pay had risen significantly, thus creating a financial hardship for a teacher with no school support. And finally, school districts no longer allowed professional development opportunities outside their own districts. Instead, teachers were required to attend professional development workshops offered within their own districts. These "training sessions" were specific to grade level, or to a school, or to elementary schools within the district, etc. Different requirements within that district responded to requirements of *No Child Left Behind* leaving little flexibility on the part of the school administration.
Cooperators for the many Teacher Days included: North Carolina State University, Wake County Schools, hundreds of teachers from other school districts in North Carolina, Minnesota, Iowa, and Ohio. Teachers volunteered their time to plan, execute, and participate in Teacher Day to make it a success. Faculty members from NC, IA, and MN, in many different disciplines volunteered their time to make scientific presentations, participate in panel discussions, and provide follow-up to those teachers and students who requested further information. Community members volunteered their resource materials. We could not have accomplished this effort without the SCI-LINK staff. We were grateful for the support and help of many different arenas.

- Grandfather Mountain International Workshop

This workshop is a residential one-week experience focused on an ecosystem emphasizing science, natural history, and culture of the area. The first SCI-LINK residential summer workshop at Grandfather Mountain was held in 1992. In those early years, we met in the mountaintop building, where we all truly experienced this unique ecosystem through rain, snow, fog, and high winds. In his yearly presentations to educators, Hugh Morton, owner of Grandfather Mountain, discussed environmental changes he had observed. He dedicated his life to preserving Grandfather Mountain, one of the most environmentally significant mountains in the world. Many acres were donated to the United Nations’ Man and the Biosphere Program, ensuring its protection for all time. Visits to the Nature Museum and surrounding habitats showcase the 47 rare and endangered species found there. Today, Crae Morton is carrying forth the vision of his grandfather presenting an historical view, an update of what is occurring today, and a vision for the future. Morton children, Jim and Kathryn are also actively involved. Recently, Grandfather Mountain became the 34th state park and natural area in North Carolina.

- Organization of the Workshop

Originally offered only to science teachers, the workshop has expanded its audience to teachers at all grade levels, from every subject area, parents, community members, representatives of NGO's such as Outward Bound, Scouts, 4-H, nature centers, correctional facilities, colleges, universities, government agencies such as state agencies, and extension. Participants come from many states in the U.S., and different countries such as Monaco, Finland (over 8 years), and Brazil (5 years). All work together to learn about the mountains. The workshop includes fieldwork, training in environmental monitoring, lectures by research scientists, and informal discussions with scientists. Emphasis is placed on sharing and learning with fellow educators. Teachers work in small groups to develop classroom activities based on current scientific research presented by workshop lecturers and use the internet to research environmental science topics. Features of the experience include:

- Housing, dining, computer and library facilities, and evening activities are at Lees-McRae College in Banner Elk, North Carolina.
- Daily activities, including lectures and field work are at Grandfather Mountain, Lees-McRae College, and other sites.
- Graduate credits, CEU credits are available.
• Educators from all disciplines are encouraged to attend. Workshop materials are provided.
• Participants have free time (though it is never enough) to explore the wonders of Grandfather Mountain and the surrounding area.

**Use of Technology**

This one-week workshop immerses teachers in the mountain environment through research presentations and outdoor activities, and requires educators to develop hands-on, inquiry-based activities to take back to their own classrooms and non-formal centers. Participants work on college computers, keep notes, research topics, download photographs, work on GIS, design new activities for home, school and other workplace settings. New technologies have been introduced and trialed during different workshops. These include GIS software, PowerPoint, Skype, and the use of video and/or digital cameras. Activities developed by the participants require incorporation of technology in a new program, new applications to be used in classrooms or non-formal locations, or a new learning technique. Workshops include environmental monitoring strategies, some of which require computers.

**Representative Topics of Study**

A representative week (this selected week from 2008) might include: Presentations by research scientists Stewart Skeate on mountain plant and animal habitats, Robert Bruck on mountain ecosystems and air quality, Amy and Wayne Van Devender on salamanders, snails, and other critters, Jack Callahan on the geology, rocks and minerals of western North Carolina. Participants met author Doris Bliss and her daughter Elizabeth Stanton to hear about past years of mountain life. Jeanine Davis presented research results on the cultivation of woodland medicinal herbs black cohosh, bloodroot, goldenseal, and ramps. Patrick Beggs discussed his work with communities on water quality issues. International presentations about education, K-12, university, in different countries including Brazil and Finland were enlightening. Rita Hagevik described GIS uses in outdoor settings, and required participants to develop classroom applications. Lees-McRae’s President and Provost Debbie Thatcher, science education, presented their expertise from a local private college viewpoint. These are some of the topic areas participants may anticipate in the summer program!

**Grandfather Mountain International Workshop Schedule, 2007**

A detailed schedule is found in Appendix B. Please note the similarity to the Teacher Day schedule – i.e., speakers/experts of specific topic areas; individual and group work, technology use, and emphasis on the educator. Activities developed by workshop participants are placed on the SCI-LINK website, initially developed by Finnish teacher/participant Kari Nuuttila in the early years. The Finns shared their expertise with the uses of technology – new to many teachers! Activities have been taught in other workshops, incorporated into publications produced by others, and/or have been the basis for further curriculum development (Bray, N. 1998). Many participants return as leaders the following year and/or participate in other professional development opportunities (Howe and Stubbs 2003). A workshop participant from the North Carolina Summer 2008 stated,
"All of the activities in this workshop have been wonderful – the information from the scientists, the new lessons that I will incorporate into my classroom, and seeing a completely different ecosystem."

Two teachers from Parana, Brazil attended the Grandfather Mountain International Workshop. Eliane stated:

"I have almost 30 years of teaching experience but this workshop was THE MOST IMPORTANT professional development activity that I have ever been involved with."

And Rosa Lúcia said,

"I was so excited with the program that I want to come back to Brazil and start writing a grant right away to put my own students in contact with the U.S. students, via videoconference. It will be a dream come true if this really happens."

We expect these Brazilian teachers to be part of the 2009 experience in Brazil!

Cooperators for this project in 2008 included: Grandfather Mountain, Appalachian State University, Lees-McRae College, NC State University, University of Tennessee, and Wake County Schools. We are grateful for their support and help in many different arenas.

The U.S. Brazillian Experience

Brazilian Christiane Gioppo arrived in Raleigh NC as a doctoral student in 2000, invited by Dr. John Penick, Chair, Department of Mathematics, Science, and Technology Education in the College of Education. She writes:

When I started my Ph.D. in Science Education at North Carolina State University, I was introduced to GIS (geographic mapping systems) in SCI-LINK workshops. While designing my research project, I introduced a portion of GIS to discuss the potential of this tool connected to non-formal experiences as a transformational experience for teacher candidates. During this time, the North Carolina University System signed a cooperative agreement with The Paraná State Research Foundation called Fundação Araucária. The Foundation offers small grants to Universities in Brazil throughout Parana state to develop many types of research. The arrangement allowed me to work closely with North Carolina State University and SCI-LINK workshops as part of my dissertation research project (Gioppo, 2004).

Gioppo added,

Since I was the first one from Brazil to participate in the workshops, I felt so very excited and involved, that I planned my dissertation and teaching (back in Brazil) to include experiences learned in the workshops. I started my research project in the methods course I offer to the undergraduate biology education program at the Federal University of Paraná in Curitiba, Brazil.

Gioppo’s project had three major steps:

- **Step 1:** In the science education methods course in Brazil, Gioppo (2004) discussed the need for teachers to teach science, and to have out-of-classroom/off-campus/field experiences with middle and high school students. Teacher candidates had to learn how to design and plan a science lesson.
- **Step 2:** In the SCI-LINK workshop in the U.S., teacher candidates (in the biology education program), science teachers and faculty members (all from
Brazil) worked together, exchanging roles and experiences, having in-depth contact with GIS, field experiences and lesson plan design.

- Step 3: Back in Brazil, in the education research methods course, teacher candidates were required to design, test and pilot their lesson plan.

- In June 2003, nine Brazilian science educators (five college undergraduates (teacher candidates), and four faculty members, 5 men, 4 women all from The Federal University of Paraná came to North Carolina for 15 days to participate in existing SCI-LINK professional development workshops. Christiane Gioppo, a graduate student at NCSU at the time, led the Brazilian participants in the program. An educator from Instituto Sangari also attended. Brazilians came from many different locations including Sao Paulo, Curitiba, and other cities. They paid their airfare and personal expenses. Workshop attendance and U.S. travel expenses were covered by SCI-LINK. During the workshops, NCSU scientists and North Carolina experts presented new information and current research on science education, technology use, and the environment. Utilizing on-site GIS the Brazilian educators were introduced to mapping and monitoring a 10x10 meter plot. The second week, the Brazilians attended the Grandfather Mountain Workshop. One Brazilian participant declared the Grandfather Mountain Workshop a "transformational experience." Still, to this day, participants communicate how valuable it was for designing classroom instruction rich in personal experience and challenging to their students.

- One surprising result of these two weeks was the depth of the candidates’ engagement with the schools, teacher candidates, and their partner teachers. We were also surprised by the depth of Brazilian faculty involvement which we had underestimated! Faculty members helped with candidates’ projects throughout the year; they attended all field trips with the teacher candidates and the middle school/high school students, keeping an eye on project development. One of the teacher candidates said of the trip to the U.S.:

> "This was the most important and relevant experience that I had during the (university) program".

- Additionally, the Brazilian high school teacher from the beach working with the teacher candidates mentioned that the students were very focused and determined to make the fieldtrip data collection work. Thus even when it was necessary to have three field trips because of storms, teacher candidates came to all three with the same excitement. They were not simply willing to teach; they were also willing to learn from the high school students, who had lived their entire lives in this (the beach) environment. Sometimes the candidates were in a teacher position, sometimes in a student position. Consequently, the high school students felt much more comfortable than if the teacher candidates had only come to provide knowledge.

- Gioppo’s plan was carried out during 2003, and included the two summer workshops (GIS and Water Workshop and the Grandfather Mountain International Workshop) in North Carolina. Despite many difficulties and roadblocks, we were still able to accomplish the following:

- All undergraduate majors (teacher candidates of biology education), almost 40, from the methods course completed Step 1 in Brazil. Only five biology education
teacher candidates and three faculty (including Gioppo) could travel to the U.S.,
due to lack of funding support. Faculty members included: one ecologist, one
geologist, and one science educator. These same individuals tested and piloted
their lesson plans with high school students (Step 3). Faculty members
supported these field activities, attending the classes together with the teacher
candidates (a unique experience for the two science faculty members in Brazil).

- Please see this link for activities and photos in Brazil:
  http://br.geocities.com/ufpr_ncsu/ric.htm

**Ongoing Communication**

- During the last six years, (2003-2008), Gioppo and Stubbs have continued to
  communicate and visit each other. Gioppo has presented at several NSTA and
  NAAEE national conferences in the U.S. Her students from Brazil participated in
  a Raleigh based GIS-Live video-conference. Stubbs has presented at teacher
  professional development meetings in Brazil and met with the State Board of
  Education. When people are able to interact and converse, the outcomes can be
  amazing and notable for other projects. The Brazilians initiated different research
  projects based on the experiences and technologies they learned in the U.S.,
  which they expanded and adapted to meet their needs and objectives. Each
  year, the Brazilian students have progressed in their individual degree programs,
  expanding their knowledge of GIS, monitoring, and the environment. They have
  developed their teaching skills in K-12 schools and non-profit organizations.

- In 2008, five years later, it is important to follow the impacts of this two-week U.S.
  2003 experience on the Brazilians. Gioppo continues to be in contact with four of
  the five students. All five students graduated with undergraduate degrees from
  the University in 2004 and all had two majors: one in biology education and one
  in the biological sciences. To accomplish this, the students were required to
  graduate in biology education; then each student was allowed an additional
  semester to finish a graduation project in the biological sciences. It is interesting
  to note that two of the candidates designed lesson plans for beach environs in
  the U.S. and then used the same topic with their Brazilian high school students
  for their graduation (Master) projects.

- One student completed his Masters at Sao Paulo University (the most important
  university in Brazil) studying bats and caves with a GIS component. Another
  studied dengue mosquitoes distribution using GIS as an important part of his
  project. This graduate is also very interested in education. He wrote a lesson
  plan about macro-invertebrates as indicators for water quality with GIS that he
  tested with middle school students. He also contributed a chapter in a book on
  assessment in science education, using the dengue fever/ GIS lesson plan as
  background to discuss alternative evaluation (Gioppo, Silva and Barra, 2006). A
  third student completed the master's degree with a project related to the beach
  environ and the use of GIS. The fourth candidate completed his master's degree
  in Ecology with the faculty member who traveled with the group to the U.S. He is
  working for a non-governmental organization (NGO) in the Atlantic Rain Forest,
  and uses GIS in his work. Interestingly, he has designed a 2009 one-week
  program for U.S. college students in and near Curitiba, following the program
design that he had shown Stubbs on one of her visits. One of the faculty members who traveled to the U.S. will be part of this program.

- Setuko, an ecology professor, was amazed at the oaks and the salamanders at Grandfather Mountain. She said,
  
- "I have been a faculty member for many years and only knew an oak tree from a photograph. Now I can tell my students what it is like to smell the oak tree, and to feel of the texture of the bark and the leaves. I can teach from my own experience. I had only seen a salamander in a jar filled with alcohol. There is only one species of salamander in Brazil. Now I can experience this on another level and share my knowledge with my students!"

Three of the Brazilian faculty members who came to the U.S. and participated in the programs in North Carolina, have been involved in the ongoing education of these four students. Stubbs states,

"I meet these same faculty members at the Federal University of Parana and the four former students, now Master's graduates, annually when I am in Brazil, with intermittent email communication during the remainder of the year. One of the students seeks to work on his Ph.D., to improve his GIS and English speaking skills, and then to study bats here in the U.S."

"It has been fascinating to follow each of these students as they progress in their fields, and to note how the Brazilian faculty members have been involved with the individual student's education and their continuing work over a number of years. We have all..."
become good friends, evolving into a much closer relationship than any of us could ever have anticipated!

Brazil: Adventures in Ecology and Education

How do we teach our students to think globally? How can we teach and learn from one another? Do these ideas transfer to our students? It is vitally important that we as educators teach and learn from those in other countries, so that we can share, cooperate, and collaboratively establish teaching and learning opportunities for the benefit of our students. In just a few short years, the world of our students will change from the world we once knew (Friedman, T. L. 2005).

We are now in our 5th year of the Brazil Adventures. We have spent one year of the program traveling in the Amazon and three years in the Pantanal. Participants include educators, scientists, business persons, university faculty, college students, and graduate students from other countries and from many states. It is essential we all participate in the developing global network, maximizing our own knowledge so we can communicate with our students, the future work force in this emerging global society.

Why International?

It is relatively easy to sign up for a travel tour to any country. However, our project is unique in its educational foci on the culture, education, and ecology of another country. We believe international experiences are essential to include in the professional development plans of educators. Today, many private and public colleges and universities insist their students have at least one international experience before graduation. And many high school students are now traveling – for service projects, church related programs, or academic programs. How are we as educators preparing our students for such experiences? Do we ourselves know anything about other countries? (Stubbs, 2008).

This program, an outgrowth from earlier work, is described in short overview format below. More detailed information can be obtained from the article (Stubbs, 2008). Please see a detailed schedule of the Brazil: Adventures in Ecology and Education, Appendix C.

Evaluation

We have found it is important that evaluations be turned in daily (for the 15 days) to the Project Director. A half-page form with just four questions is easily and quickly answered, and scanned by the Project Director and staff. It is then possible, for example, to provide more comfort for the participants such as changing the seating on the bus, providing more stops along the way, or having bottled water available on the bus. We can also change schedules should participants need more rest time. With so many distinct personalities in close contact every day, sometimes there needs to be individual time-out. And so on. Presently, we are developing an on-line evaluation form...
to be returned daily to the home office for tabulation. This will save major time commitments of staff in 2009.

Laptop for Participants

During the 15-day adventure, there are group questions and answers. Frequently one question will be an evaluative one, to ascertain where the group is in the development of a specific topic. Additionally, the final evaluation of open-ended questions will be administered via computer. We hope to have this available for 2009 experiences with a computer for each person. Let’s see!

The final project of each participant must involve technology. These projects will be placed on the website and shared with others. From previous experience, there are innovative ways to share with and between international teachers and students – but this has taken much longer than anticipated for these to reach actual implementation. In 2009, we will explore other programs, discerning what barriers are present, and compare possible strategies to reach positive outcomes.

Update

We have just returned from the 2009 Grandfather Mountain International Workshop with eleven participants including those in community college, universities, middle school, high school, extension and interested others from Ohio, North Carolina and Brazil. Compared with our first workshop so many years ago in the same locale, we note: wireless is now available throughout the college – in the dorms and the offices. We spent little time in the computer room except to print, download large files or as a total group, to learn new programs. Participants started and contributed to a Wiki, learned how to use concept maps via computer, and began to think about the expanded use of technologies within this workshop and at our home sites. Participants brought their own laptops and worked in their rooms, writing applications for what they had learned, to be used in their home environ. Individual cell phones usually worked with little problem – what a difference when formerly we had to find a pay phone to call home. Many necessary ‘steps’ needed early on, have been collapsed or deleted! What changes from almost 20 years ago!

Summary

These one-day, one-week, two-week experiences have served as a pilot study to delineate techniques, strategies, and methodologies to be used in the future, as this type of professional development reaches larger and larger audiences. We have learned that people enjoy working together to learn and share ideas; they are eager to collaborate across state and international boundaries and they want to interact with others. These workshops have fostered an enthusiastic ‘esprit de corps.” We know what works; we know what does not work. This framework can be exported to the study of other countries’ education, environment, and culture. We believe this approach to be important in the evolving saga of professional development, always remembering that it
takes time and patience to develop such ongoing programs. Outcomes may not be known for some months, or even years. Technology continues to change, presenting challenges as well as solutions.

“A successful program takes input from many, an uncanny split-second sense of timing, flexibility, not staying with the schedule as written but going with the flow during the experience, extraordinary energy, serendipity, and sometimes luck!”

Acknowledgements:

We wish to thank: Ben Sangari, President Instituto Sangari, for his support and commitment to this project; Bianca Rinzler, Ingrid Imenez, Sangari organizer and educator Arlita McNameee, Mariana Reis, and the Staff of Instituto Sangari.

We wish to thank: John Penick, Department of Mathematics, Science, and Technology Education, NCSU; Sharlene Simon, NCSU, Alex Davis and Dee Davis, SCI-LINK staff for their help and encouragement.

We wish to thank: Christiane Gioppo, Setuko Masunari, Donizeti Giusti - Faculty, Federal University of Parana, Brazil, and former students Ricardo Vieira de Silva, Daniel Luis Lepka, Ives Arnoni, Bruno de Andrade Matuella and Aline Luise Bail.

And we are indebted to all the participants of this unique type of international professional development experiences for educators.

References


dissertation under the supervision of Dr. John Penick and Dr. Glenda Carter.


Websites

Websites specifically referred to in this article are:

**SCI-LINK**  [www.ncsu.edu/scilink](http://www.ncsu.edu/scilink)

**Instituto Sangari**  [www.institutosangari.org.br](http://www.institutosangari.org.br)

**Federal University of Parana**
- [http://br.geocities.com/ufpr_ncsu/ric.htm](http://br.geocities.com/ufpr_ncsu/ric.htm)

SCI-LINK, a project supported by the National Science Foundation and many others from 1991-1996, continues today – connecting/ linking research scientists and experts with teachers and students to bring cutting-edge environmental science quickly and directly to the classroom.

It is hoped that this paper provides incentives for educators to 'think out of the box', dare to be innovative in approaches, try new and different techniques and strategies, learn new information directly from the sources regardless of viewpoints, and to plan long-term programs and projects for optimal outcomes.

Authors

Harriett S. Stubbs, Ph.D. is an Associate Professor Emeritus, member of the Department of Mathematics, Science and Technology Education since 1988, and located in the Office of Professional Development at North Carolina State University. She is Director of the SCI-LINK/ GLOBE-NET Projects, author of books and articles, presenter of methodologies and strategies for professional development of educators and environmental topics of interest for teaching and learning. Stubbs has developed and coordinated professional development experiences for educators for more than 25 years in the U.S. and for more than five years in Brazil.  [H.Stubbs@ncsu.edu](mailto:H.Stubbs@ncsu.edu)
Appendix A

TEACHER DAY: GLOBAL CHANGE

The Faculty Club – NCSU
March 17, 1995
8:30 am – 3:30 pm

8:00-8:30 am Registration

8:30 Welcome: Dr. Harriett Stubbs, NCSU

THE CHALLENGE OF GLOBAL ENVIRONMENTAL CHANGE

8:40 PHANTOM ALGAE; Implications and global significance
Dr. Joanne Burkholder, College of Agriculture and Life Sciences, NCSU

9:20 OZONE AND CARBON DIOXIDE; Atmospheric components in global change
Dr. Viney Aneja, College of Physical and Mathematical Sciences, NCSU
10:00 LYME DISEASE: An example of human health affected by human decisions
Dr. Jay Levine, College of Veterinary Medicine, NCSU

10:40 BREAK – VIEW EXHIBITS

11:00 ENVIRONMENTAL ESTROGENS: Potential Effects on Wildlife & Human Reproduction
Dr. John Vandenbergh, College of Agriculture and Life Sciences, NCSU

11:45 pm LUNCH AND LUNCH SPEAKER:
GLOBAL ISSUES IN YOUR CLASSROOM
Dr. Robert Yager, Director, Science Center, University of Iowa

12:45 THE CHANGING FACE OF FOREST ECOSYSTEMS:
Examples from three continents
Dr. Robert Bruck, Assistant Vice-Chancellor, Research, Outreach & Extension, NCSU

1:30 MONITORING THE ENVIRONMENT: What can you and your students do?
Dr. Walter Heck, US Department of Agriculture

2:15 GLOBAL ISSUES AND NC STATE GUIDELINES
Ms. Brenda Evans, NC Department of Public Instruction
Examples by Teachers: Tonya Hancock, Nancy Bray

2:45 WHERE DOES THIS FIT INTO MY CLASSROOM? Brainstorming & Reports
Master Teachers: Annie Bullock, Charles Gunter, Rita Hagevik,
Faye McDaniels, Fred Hatley, Dan Larson (MN), Nick Scandale,
Steve Stevens, Charles Tysinger, Laurie Peterman (MN)

3:00 Wrap-Up
3:30 Adjourn
Appendix B

Grandfather Mountain International Workshop Schedule
June 18-22, 2007

Monday, June 18 LD

12:00-1:00 LUNCH at Lees-McRae College Cafeteria, Banner Elk NC
1:00 CHECK-IN at Village Dorms (ck map if you don't get there for lunch)
1:45 Introductions - Dr. Harriett Stubbs, SCI-LINK/GLOBE-NET Honors Lounge

Week's SCHEDULE, OBJECTIVES, ACTIVITIES

Notebooks /handouts, Blank Books, NSES, Journaling – What is it?

SMALL GROUPS

Your Project and your expectations. Arrange car pools for the week; Digital/Video-camera assignment

2:15 Lees-McRae College - Admissions

2:30 GLOBAL ISSUES IN SCIENCE

Pilot Study with Lawrence Hall of Science, U of CA and NSF

Michael Tally, Science Supervisor, Wake County Schools

3:30 HIKE HEMLOCK HILL

5:00-6:00 Dinner, College Cafeteria

6:00-8:00 COMPUTER LAB, Begin projects

Thomas, Nain Singh, Orientation to Computer Lab
6:00-6:30 ONE FINNISH PRESENTATION

Tuesday, June 19 Banner Elk/ Grandfather Mountain BLD

7:00 Breakfast. Make bag lunch

7:45 PARTICIPANT SHARING (2) – Honors Lounge

8:15 Leave for Grandfather Mountain, Linville NC

8:45 Top of the Mountain, Swinging Bridge

9:00 GRANDFATHER MOUNTAIN – UN Biosphere Reserve Site
Mr. Crae Morton, Grandfather Mountain Nature Center

9:45 Questions

10:00 TOUR MUSEUM, TOUR ANIMAL HABITATS
Naturalists, ½ group Museum; ½ group Habitats, Exchange

12:00 Bag Lunch

12:30 EXPLORE ON YOUR OWN

On the way to Banner Elk, visit Historic Linville, Julian Price Park, Blue Ridge Parkway and Moses H. Cone Craft Center or hike Grandfather Mountain trails, Linn Cove Viaduct Visitor Center (trail closeby)

3:30 HOOT OWL HOLLER – A Mountain Story Teller Honors Lounge
Doris Bliss, Valley Crucis

4:15 UNIQUE APPROACH TO BEHAVIOR
Elizabeth Jaynes, Hickory School District

5:00 Dinner

6:00-8:00 COMPUTER LAB
Digital Cameras and Power Point

6:00-6:30 ONE FINNISH PRESENTATION

Wednesday, June 20 Lees-McRae College BLD

7:00 Breakfast. Make bag lunch
7:45 Participant sharing 4; Small Groups - Projects Honors Lounge
9:00 GEOLOGY OF THE NC MOUNTAINS and NEW ZEALAND IMAGES
Dr. Jack Callahan, ASU Honors Lounge
9:45 Questions
10:00 DRIVE TO ROAN MOUNTAIN, to see the Rhododendron Gardens, the largest collection of these plants in the world; Visit the Museum
12:00 Bag lunch on the mountain
3:00 RETURN TO LEES-MCRAE or EXPLORE ON YOUR OWN
Options: Linville Cave, Valle Crucis Historic Sites, Linville Falls, et al
5:00 Dinner
6:00-8:00 COMPUTER TIME to develop project
6:00-7:00 INTERNATIONAL EDUCATION: Latin America, Belize and Brazil
Michael Tally, Science Supervisor, Wake County Schools
8:00-10:00 MOUNTAIN SALAMANDERS: Wayne and Amy VanDevender, ASU

Thursday, June 21 Boone BLD

7:00 Breakfast Make bag lunch.
8:00 Meet in Lobby - participant sharing (4)
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>9:00</td>
<td>INTRODUCTION TO MOUNTAIN ECOSYSTEMS</td>
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<tr>
<td></td>
<td>Teaching global field courses (Costa Rica, Australia, etc.)</td>
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<tr>
<td></td>
<td>Dr. Stewart Skeate, Lees-McRae College</td>
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<tr>
<td>12:00</td>
<td>Bag lunch at Field Site</td>
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<tr>
<td>1:00</td>
<td>Return to Lees-McRae</td>
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<tr>
<td>2:00</td>
<td>PLANNING, DEVELOPMENT OF YOUR ACTIVITIES</td>
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<tr>
<td></td>
<td>HONORS LOUNGE</td>
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<tr>
<td>5:00</td>
<td>Dinner</td>
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<tr>
<td>6:00-9:00</td>
<td>PRESENTATIONS BY PARTICIPANTS – INDIVIDUAL, GROUPS HONORS</td>
</tr>
<tr>
<td></td>
<td>LOUNGE</td>
</tr>
<tr>
<td></td>
<td>One page Blank Book Page Sharing</td>
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</tbody>
</table>

**Friday, June 22 Lees-McRae College, Grandfather Mountain BL**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:00</td>
<td>Breakfast</td>
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<tr>
<td>8:30</td>
<td>Check out of dorms, return all keys</td>
</tr>
<tr>
<td>9:30</td>
<td>GROWING NATIVE WOODLAND BOTANICALS</td>
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<td>HONORS LOUNGE</td>
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<td></td>
<td>Introduction to popular native medicinals (ginseng, goldenseal, black cohosh, bloodroot, mayapple). What they look like, roots, flowers, leaves, botanical name, where they grow, propagation. Traditional and current uses. Active constituents. Resources to learn more.</td>
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<td></td>
<td>Dr. Jeanine Davis, Fletcher NC, NCSU</td>
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<tr>
<td>11:30</td>
<td>Drive to Grandfather Mountain</td>
</tr>
<tr>
<td>12:00</td>
<td>Top of Grandfather Mountain</td>
</tr>
<tr>
<td>12:30</td>
<td>GLOBAL CLIMATE CHANGE EFFECTS ON MOUNTAIN ECOSYSTEMS</td>
</tr>
</tbody>
</table>
Appended C

Brazil: Adventures in Ecology & Education

Schedule 2007

Sao Paulo Week One

- July 13: Morning arrival on international flights. Opening luncheon 12:00 noon. Orientation to Brazil, a unique country. Sao Paulo city tour of historic buildings, parks, and cultural entities. Visit Genome Exhibit (from the American Museum of Natural History, NY) and artisan craft fair at MASP.
- July 14: Experts discuss Brazilian education, society and culture. Visit and tour local private school. Learn about special Brazilian foods. Walk through neighborhoods to local restaurant for dinner.
- July 15: Examine flora and fauna of Brazil at the Flower Market; learn from the director of the renowned Butantan Institute, producer of anti-venum vaccines and serums; examine responses to the plague at the Museum of Microbiology; visit a public school.
- July 16: A day in the Atlantic Rain Forest at the Parque Estadual da Cantareira. Hiking trails, museum and research presentations. Vegetation to 30 meters, trees to 40 meters. Great diversity of plants, many still unknown to science.
- July 17: Visit and tour the Sangari Institute. Quality education and curricular materials investigation. University faculty share research. Walk through and visit book and music stores at a popular mall. Identify large variety of Brazilian rocks and minerals.
- July 18: Flight to Campo Grande; visit Dom Bosco Museum collections of 10,000 insects, 7,000 butterflies, and local Indian history. Travel to posada in Pantanal; explore, and view along the way caiman, rhea, blue macaw, capybara, deer, and giant anteaters.
PANTANAL WEEK TWO

- July 19: Walk, hike on foot to observe the fauna in fields, savannas and woods. Natural habitat area for more than 650 different bird species, such as the American rhea, tuiuiu, toucan, egret and many others. Lectures by naturalist, university faculty, and environmental educator – what is significant about the Pantanal?
- July 20: On horseback, observe and photograph in fields, cerrado and forest. Fish from Aquidauana riverbanks. Nocturnal animal watch: caiman, giant anteaters, crab fox, small anteater, capybara. Visit Pousada school; owners talk about fossils and the history of this pousada.
- July 23: Group presentations. Local Recycling Cooperative and NGO where families use recycled materials to support education. Higher education in Brazil.
- July 26: Last minute packing. Arrive at Guarulhos Airport by 6pm for international flights home.