REMOTE SENSING RESEARCH IN UNDERGRADUATE EDUCATION: AN INTERNATIONAL FIELDWORK PERSPECTIVE

Christopher D Storie, PhD[1] & Joni Bugden-Storie, PhD[2]

[1]Geography Program, Winthrop University, Rock Hill, South Carolina, storiec@winthrop.edu
[2]Natural Resources Conservation and management Program, Department of Geosciences and Natural Resources Management, Western Carolina University, Cullowhee, NC, jbugden@wcu.edu

1. INTRODUCTION

Institutions of higher education in the U.S. are increasing their use of project-based courses and experiential learning using projects or service in other countries. These approaches are particularly applicable to remote sensing (RS) technology due to the complex and diverse nature of the discipline, the efficacy of experiential learning, the need to learn about other regions and countries and the fact that remote sensing imagery is of the real world and can be easily and directly connected.

Project-based instruction provides students with an opportunity to make connections between the classroom and the world around them. However, there are pedagogical, logistical and operational challenges that must be addressed when implementing undergraduate teaching-scholarship model. This project integrated education and research outcomes with the assistance of a USDA Cooperative State Research, Education, and Extension Service (CSREES) grant awarded in 2008. The goal of this project is to enhance WCU collaborative undergraduate research capabilities through curriculum development, international experience and research. To accomplish this goal, geographic education literature was explored, two courses were developed, international participation in field data collection and workshops was conducted, and undergraduate research projects were cultivated.

2. LITERATURE BACKGROUND

Geographic education literature for remote sensing and GIS projects is focused on the fieldwork component of the project rather than the geospatial analysis component. Warburton et al [1] wrote that "field-based learning is a highly diverse activity in its aims, methods and value. It is commonly argued that a major advantage of fieldwork is that it is 'real' and objects are viewed in their natural context." Fieldwork is defined by Gold et al [2] as "any arena or zone within a subject where, outside of the constraints of the four walls classroom setting, supervised learning can take place via firsthand

experience". From a remote sensing perspective this statement could not be any more valid. Satellite images are acquired and, in most all cases, some type of *in situ* data is collected to validate image results. This validation process places a high importance on fieldwork and therefore provides the opportunity to connect the classroom to the natural and human world around us [3]. Additionally, the teaching of remote sensing can benefit directly from field work as a pedagogical exercise in addition to data validation.

Kent et al [4] suggests that participatory fieldwork automatically engages student attention and deepen the learning experience; however, they also suggest that participatory fieldwork has three drawbacks. These include; (1) the need for extensive preparation in order to ensure a satisfactory outcome, (2) project work is more time consuming than other fieldwork approaches, and (3) it can be difficult to supervise adequately for health, safety, and academic reasons. The recommendation is that faculty learning any type of field-based learning need to be well prepared, anticipate needs when at the field site, and be aware of potential challenges from both a cultural/personal as well as logistical perspective.

Four stages of fieldwork activity identified by Kent et al [4] are; (1) preparation and briefing where students are made aware of the academic context in which the fieldwork will take place, (2) engagement in the activity where students are required to determine a field collection procedure, (3) processing the results of the activity when the collected data is analyzed in context, and (4) debriefing and feedback when a review of the experience is conducted. The significant value of this type of student-orientated fieldwork is that they see the benefit of their work directly and how it can and will be used in future for both educational and research needs.

3. PROJECT OVERVIEW

The goal of this grant was to increase the international content of existing curriculum by providing to students advanced skills in sampling design, geospatial statistics, and remote sensing for mapping and monitoring of crops and natural areas including semi-arid mountains, sub-tropical mountains, and tropical rain forests. These advanced skills would then be applied through an experiential learning project that would allow students to gain an understanding of the global dimension of their studies and thus better equip them to address resource conservation and management issues within their own local context.

A substantive part of international project-based courses involves preparation for foreign travel. In our project, the students were responsible for (a) securing their own passport, (b) getting the necessary inoculations as determined by the Centers for Disease Control, and (c) securing of visa documents for travel into Brazil. This pre-travel responsibility promoted individual responsibility by the students and prepared them for a maturing experience as, for many students, this was their first time outside of the United States. In total, nine students and two faculty members participated in the international trip which involved participation in workshops and field data collection. Faculty members from both genders were present on the trip so that leadership would come from both genders to address all students' needs.

4. OUTCOMES

As a result of this project, two courses have been developed and taught (NRM470 Land Class Suitability and GEOG424 Advance Remote Sensing) in fall 2008 and spring 2009, respectively. These courses will be taught again in fall 2010 and spring 2011, on a two year rotation. The outcomes proposed and met in the NRM470 course included (a) knowledge of classification schemes, (b) development of sampling designs appropriate for various scales, (c) analysis of field data using geospatial statistics, and (d) implication of scale on decision making. Prior to departure to South America, the students learned how to design and plan field data collection appropriate for landscape analysis [3], collected and analyzed the data for a western North Carolina deciduous forest mapping project, and completed substantive field data analysis reports using scientific methodology. The outcomes proposed and completed in the Advance Remote Sensing (GEOG424) course included (a) learning radar physics and concepts, (b) exploring target-polarization interaction theory, and (c) learning how to use PolSARpro (polarimetric image analysis software).

As a result of the student experiences in NRM470 and GEOG424, the students participated in the international field work component for detection of land-cover changes in a semi-arid environment (Argentina) and participated in workshops teaching polarimetric radar software in Argentina and Brazil in March 2009. The NRM470 students assisted in methodology planning and collection of in situ data while the knowledge from Geog424 was used to assist participants in a polarimetric radar workshop and for some students, to do a presentation at an international workshop.

In April 2009, upon return from South America, the students in Geog424 (a) built a database of field data collected and documented their methodology, (b) performed exploratory analysis to extract

biophysical features from polarimetric radar data (e.g., wetland mapping, forest structure mapping, turtle habitat mapping). The projects and international field experience exposed students to a variety of ecosystems, management strategies and decision making for those landscapes. The final student presentations in the Advance Remote Sensing class were attended by faculty in the department and Doug Newcombe, US-FWS Raleigh (who is planning radar acquisitions for the wetland mapping in NC).

This experience for the students has opened their eyes to new cultures and environments. Students have developed friendships with students in Argentina and Brazil and continue to keep in touch through email and social networking sites. Upon graduation, one student attributed this South American experience as the impetuous for her participation as an interns for a turtle tracking project in Costa Rica (Fall 2009).

These efforts have resulted in the institutionalization of the NRM470 course into the NRCM curriculum (GEOG424 was already in existence). The development of these courses has also contributed to more clearly defined course goals and outcomes within the NRCM program. For example, this experience has resulted in better defined learning objectives and the incorporation of the scientific method within selected courses. Additionally, the NRCM program has also recently incorporated a yearly field trip that emphasizes field data collection, encourages cohort bonding and retention of students in the program.

All students and collaborators now have a clear understanding of field data collection methodology appropriate for polarimetric radar data as a result of this work. In addition, all of the participants have a better understanding of radar theory, applications, software and research methodology. Dissemination of activities include two international workshops in Argentina and Brazil (March 2009), a report documenting the field data collection methodology and summary of descriptive statistics (written by two students and the PI), and presentation both education and research goals by student and faculty at local, regional and international.

5. REFERENCES

[1] Jeff Warburton, Martin Higgitt, and Barbara Watson, "Improving the Preparation for Fieldwork with 'IT': Preparation Tutorials for a Remote Field Class," *Journal of Geography in Higher Education*, vol 21, no 3, pp 333-339, 1997.
[2] J. R. Gold, A. Jenkins, R. Lee, J. Monk, J. Riley, I. Shepherd, and D. Unwin, *Teaching Geography in Higher Education*, Oxford University Press, London, 1991.
[3] R. McCoy, *Field Methods in Remote Sensing,* Guilford Press, New York, 2005.
[4] M. Kent, D. G. Gilbertson, and C. O. Hunt, "Fieldwork in Geography Teaching: A Critical Review of Literature and Approaches," *Journal of Geography in Higher Education*, vol 21, no 3, pp 313-332, 1997.