

# Integrating Opportunities: Applied Interdisciplinary Research in Undergraduate Geography and Geology Education\*

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## Abstract

Unique integrative learning approaches represent a fundamental opportunity for undergraduate students and faculty alike to combine interdisciplinary methods with applied spatial research. Geography and geoscience-related disciplines are particularly well-suited to adapt multiple methods within a holistic and reflective mentored research paradigm. The case study presented is successful geography-geology collaboration at a regional comprehensive university. Faculty participation allowed them to broaden the scope of their research and expand cooperative relationships within the academy, while students benefited from a wider context for disciplinary training, improved community engagement, and professional development opportunities.

**Keywords:** interdisciplinary research, undergraduate geography, applied geography, faculty development, community engagement

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## Introduction

Enthusiasm for interdisciplinary research is apparent in diverse contemporary academic settings. From community colleges to universities at which “cutting-edge” research is conducted, many administrators and faculty members see great potential and advantages in organizing scarce resources and sharing expertise among departments. Much has

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been made of both the unique potentialities and possible pitfalls of interdisciplinary work for faculty. Yet the question remains open as to how being part of an interdisciplinary research team might affect students, particularly at an undergraduate level. Such a program might broaden their methodological horizons, integrate different classroom experience in an applied setting, and help to focus on the concept of critical thinking while providing a basis for the idea that many issues need multiple perspectives to be properly understood.

Extensive literature has been devoted to interdisciplinary research (Larson, Landers & Begg, 2011; Lélé & Norgaard, 2005; Committee on Facilitating Interdisciplinary Research, 2004). The rationale of interdisciplinary investigations is to draw on strengths from multiple, diverse academic traditions to surpass what might be accomplished within the framework of a single, narrow approach (Youngblood, 2007, p. 2). Because many of today's critical environmental issues are the result of complex dynamics between the physical and social realms, integrating multiple theoretical approaches holds promise for providing pertinent advice to decision-makers (White, Cinderby, Raffaelli, Bruin, Holt & Huby, 2008, p. 415). Crossing traditional disciplinary borders is not without risk; those mediating academic divides are potentially open to criticism and resistance from colleagues on all sides (Donovan, Sidaway & Stewart, 2010, p. 10). Yet the latitude of approach offered by such inclusive work continues to attract proponents. Open communication and flexibility become imperative to success in interdisciplinary endeavours (Oughton & Bracken, 2009, p. 385).

Geography, with the long-standing tension between physical and human aspects of the discipline, in many ways internally mirrors the external duality experienced within interdisciplinary research. Competing and often conflicting narratives have shaped the modern geographic discipline (Livingstone, 1992, p. 347). The wide and varied approaches housed under the geography banner today have lent it the label "bridging discipline" (Youngblood, 2007, p.2). This concept sees the study of the earth as a vast, inclusive practice. By such estimation, the geographic practitioner is uniquely suited to undertake cross-disciplinary work. Factor in the reality of co-housed geography and geology programs that are also well-seasoned in integrative practices, and one has a great depth of experience in the mechanisms needed to ensure success.

Another strength of the geosciences is their ability to integrate knowledge obtained across a wide variety of study areas into meaningful student experience, drawing not only from the diversity within the discipline but also folding in cross-campus educational exposure in the social sciences, humanities and more. Integrative learning seeks to reinforce and connect concepts learned in the traditional classroom with activities and involvement incorporating the larger community; practical, applied activities can help enhance these curricular linkages and improve such holistic learning outcomes (Mentkowski & Sharkey, 2011, p.95). Actively involving students in the learning process, having them acquire and analyze their own data, is vital in today's university environment (Fromhold-Eisebith, Freyer, Mose, Muhar, & Vilsmaier, 2009, p.411). Geospatial technologies and environmental analysis are two particularly useful

frameworks through which students engage in comprehensive, meaningful inquiry (Klein, Fatima, McEwen, Moser, Schmidt and Zupan, 2011, p. 425). Regardless of the approach, linking critical inquiry with practical action is extremely useful in student growth (Healey, 2005, p. 195) and often results in a deeper and more robust grasp of concepts.

This paper presents the experience of an interdisciplinary (geography-geology) research team at a regional comprehensive university. Eastern Illinois University has prioritized the integrative learning concept within undergraduate and graduate studies. The institution's goal is to make connections between isolated classroom knowledge and real world experience for the students, providing greater context for the university experience and better preparation for applied careers. As part of this initiative, professors in the geosciences at Eastern have made a conscious effort to recruit undergraduate students from both the geology and geography majors into cooperative efforts, grounded in a local and applied research project.

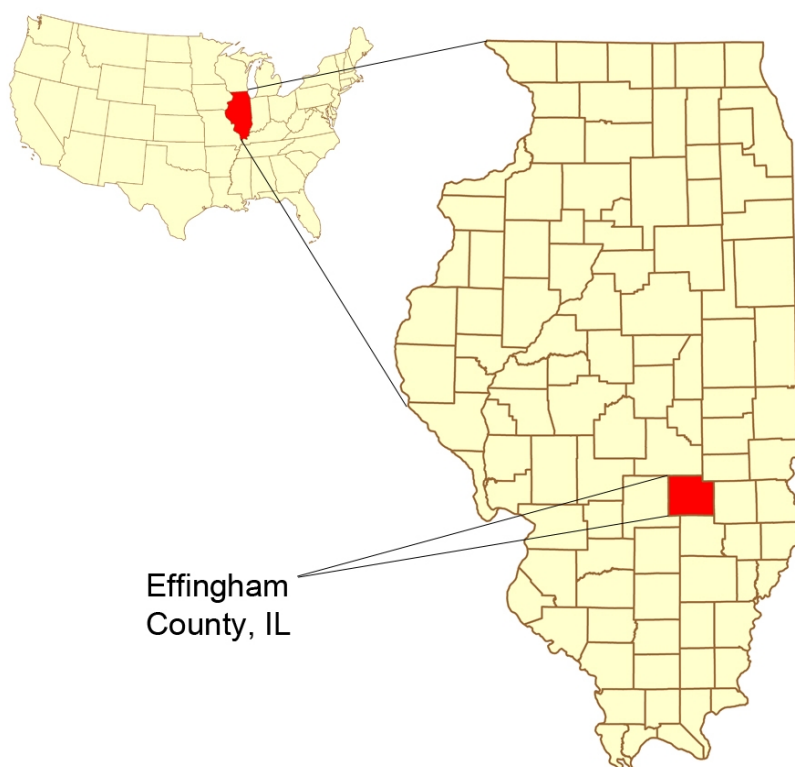
The resulting project serves as a possible template for interdisciplinary efforts at other universities. Easily replicated in other locations, the work not only provided an excellent opportunity for the undergraduate participants to expand marketable skills and enhance professional development, it engaged students from varying backgrounds across the state in an issue of great importance to the local rural economy and created new connections with the community surrounding the university.

## **Research methodology**

Providing exceptional integrative learning opportunities for undergraduate and graduate students alike is a central goal at Eastern Illinois University. Eastern, a regional comprehensive university in the Midwest with a population of approximately 11,500 students has established an integrative paradigm as a core pillar of the university experience (Eastern Illinois University, 2011). This effort extends beyond the curriculum to encourage integrative inquiry between disciplines as well as among students and faculty. Helping students blend technique and theoretical knowledge acquired in diverse classes during hands-on, experiential research broadens their institutional and community involvement while developing a deeper level of disciplinary understanding.

Eastern Illinois University is located in the city of Charleston, within the primarily rural county of Coles. Eastern draws students from diverse locales, but a significant group of students comes from urban or suburban settings. Almost 40% of students are from the Chicago metropolitan area alone (Eastern Illinois University, 2012). Engagement with the local population is often limited to a narrow strip of businesses near campus catering to student needs. Student experience with the agricultural way of life dominating the local landscape is even less, limited to driving past hundreds of miles of corn and soy fields on their way to or from campus. As such, many undergrads have a grasp of issues important to the local economy and environment which is somewhat tenuous at best. In order to engage those students with local stakeholders, issues of community importance are essential to the undergraduate research agenda at Eastern.

With community involvement in mind, a collaborative project was defined by faculty members from the geography and geology disciplines at Eastern. Though housed in the same department for several decades, there is little history of joint research efforts between these groups of faculty. This project, therefore, presented an opportunity for faculty growth and outreach as well as enhancing the student experience. Beyond simply defining the interests of faculty members, student “buy-in” and community relevance were prioritized in preliminary deliberations. Faculty felt it was also important to involve students from both disciplines, allowing them the opportunity to share skills and broaden horizons for all participants.



**Figure 1.**  
*Location of Interdisciplinary field study*

The study that took shape, with input from all sides, centered on an approximately 20 mile reach of the Little Wabash River in Effingham County, Illinois (Figure 1). The Little Wabash River is a meandering river flowing from Southwestern Coles County, Illinois to its confluence with the Wabash River along the Illinois-Indiana border (Figure 2). The portion of the watershed within the study area is primarily devoted to agricultural uses, particularly the production of corn and soy (Illinois Environmental Protection Agency, 2006). The first practical goal of the project was to define areas of channel change along this stretch of river. Because land holders on opposite sides of the river usually differ, changes in channel path may have a direct impact on field productivity and economic outcomes. Beyond simple mapping of morphological

change, questions of impact on local stakeholders were a key concern. The final study, therefore, had two primary goals: to ascertain what channel changes have occurred over a 70 year period and to discover if those changes have impacted land ownership and usage patterns.



**Figure 2.**  
*Little Wabash River at Rt. 45 near Sigel, Illinois*

From a faculty perspective, the defined, limited scope of the study had several important advantages. It was a tangible way of allowing the university to contribute to an issue of vital local importance. At the same time, these questions could be answered using accessible data, techniques and concepts with which the students were familiar from class work. Finally, while contributing original applied research (no exploration of channel change on the Little Wabash has been conducted before), the study area was located within an hour of the university itself. This provided large benefits logistically and financially in terms of travel.

The unique student opportunities created by this project also played a key role in its success. The interdisciplinary and integrative components of the plan helped to secure internal grant funding. This assured the ability to provide undergraduate student stipends for the mentored work. Three students were selected for the project. One geographer was chosen for her skill and acumen with GIS and remote sensing techniques. Two geologists were also selected for strong backgrounds in geomorphic processes as well as their expertise in field work. The team assembled combined skill-oriented spatial analysis, on-the-ground experience, and a solid underpinning in sedimentary processes and fluvial dynamics.

The 70 year time frame of the observation of morphological changes along the channel was chosen based on the availability of photo archives from the late 1930's. An extensive aerial survey of most of the state of Illinois is available for 1938-1939 via

the Illinois Natural Resources Geospatial Data Clearinghouse. This archive consists of some 33,000 panchromatic vertical images scanned and compressed for digital distribution. While presenting tremendous potential for land-use change and comparison studies, images are un-registered, requiring significant pre-processing and registration work before use.

Acting under supervision of the geography faculty mentor, the GIS undergraduate employed techniques learned in earlier remote sensing classes to orthographically correct the imagery and register it to ground coordinates. Portions of 8 overlapping images from 1938 were used to provide a comprehensive, rectified view of the Little Wabash channel within the study area. This work proved challenging, as finding points of commonality between images obtained at different resolutions 70 years apart can be difficult. Unchanged railroads, county roads, and bridges provided the best points of reference. In some cases visible property boundaries were used when it could be ascertained that field divisions were unchanged during the study period. After ensuring positional accuracy, the same student set about delineating channel boundaries for the imagery. Left and right boundaries were determined for the 1938 image as well as a co-registered USGS quadrangle map revised in 1984. Differences were readily apparent, even at this early stage.

Meanwhile, a comprehensive survey of the river banks in 2011 was planned, using detailed GPS readings and survey techniques. Initial field work was carried out with student workers in the Spring and Summer of 2011. While this assessment of the study area focused on points of river access and provided familiarity to participants, a better understanding of ground conditions also turned up an unexpected difficulty. Property law in Illinois means access to river banks along the reach in question was limited to public easements at road and rail crossings. Obtaining prior written permission from dozens of landholders was wholly unfeasible. While surveying work could be conducted from within the channel itself, much of the river was either blocked by debris or at very low levels. Using water access, therefore, was also unpractical.

This presented an urgent logistical challenge to the team. While centimeter-accuracy GPS readings along the bank would naturally create the most accurate dataset, the types of landscape change being sought were evident at a much coarser scale of measurement. Therefore, for contemporary bank boundaries, the group turned once again to remote sensing. Imagery for the year 2008 was available at 4 meter resolution via Digital Globe Corporation's Quickbird satellite. Bank accuracy could be determined from this satellite view with a similar veracity to the original panchromatic aerial photos. Fortuitously, the satellite imagery coincided with the 70th anniversary of the original aerial photo acquisition. The image dataset was also acquired 2 days after a flood event, showing the river at bank-full level and making discernment of the boundaries more accurate. Students turned to this data for processing and extracting accurate outlines of the river edges. Where possible, these measurements were correlated with observations at public easements. The overall interdisciplinary template of the project and the flexibility of faculty mentorship allowed the shift in approach and kept the project from failing.

Students calculated areal changes for land throughout the study area, by extracting and measuring polygons in GIS. For the 20 mile length of river under consideration, team members identified 13 changes of 2 acres or greater in magnitude. While many of these shifts were relatively small (2 to 6 acres of magnitude), one particular change involved 192.27 acres (Table 1). Altogether, some 241.37 acres of land were displaced from one side of the channel to the other over these seven decades. This total area accounts for .08% of the county's entire acreage.

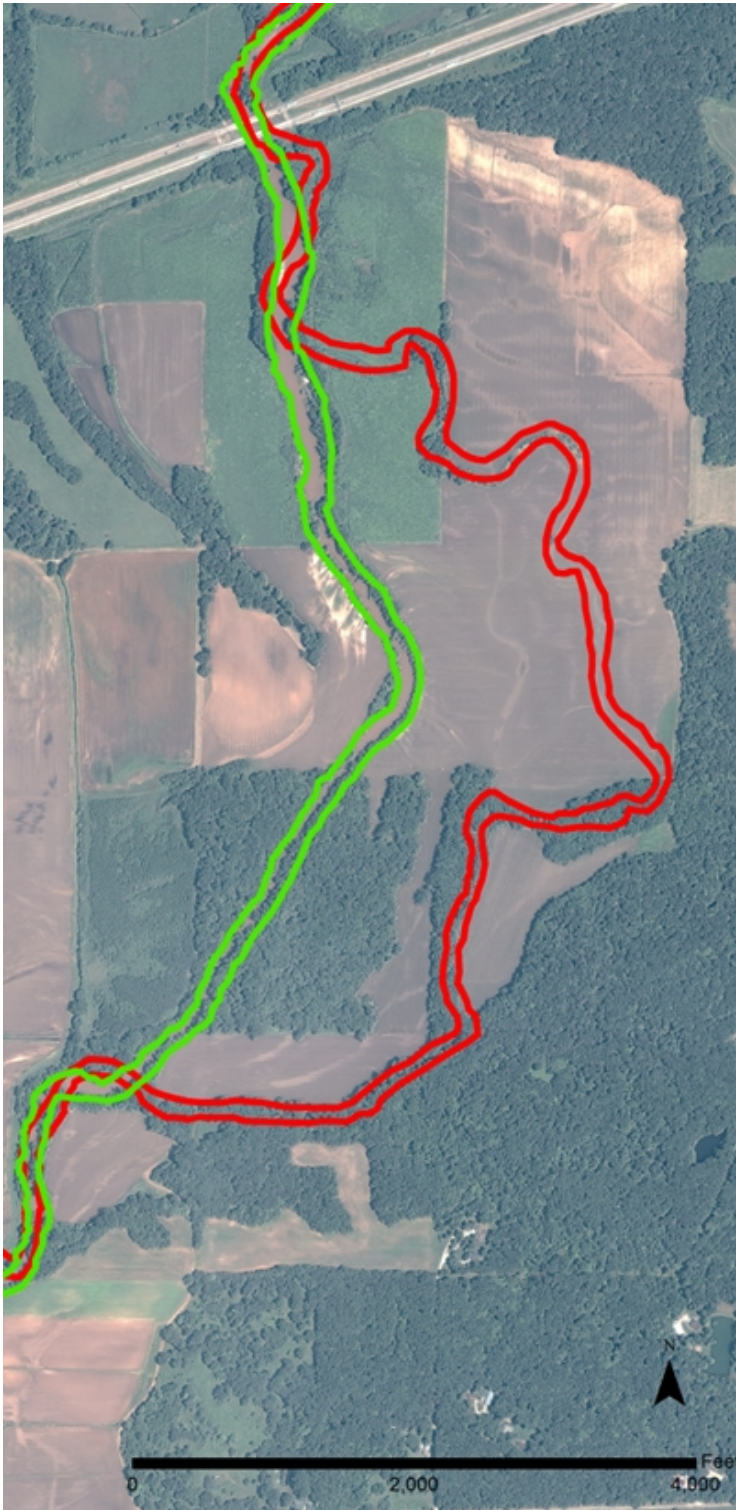
**Table 1.**

*Meander Cutoffs, 1938 to 2008*

<b>UTM Coordinates (Zone 16N)</b>	<b>Acreage Impacted</b>
-88.246, 39.044	4.98
-87.602, 39.072	3.63
-88.591, 39.081	192.27
-88.594, 39.090	2.98
-88.589, 39.103	6.2
-88.597, 39.109	2.98
-88.581, 39.132	2.95
-88.576, 39.145	6.12
-88.587, 39.165	4.8
-88.593, 39.166	2.3
-88.617, 39.032	4.32
-88.627, 39.032	2.6
-88.615, 39.021	5.24
<b>Total Acreage</b>	<b>241.37</b>

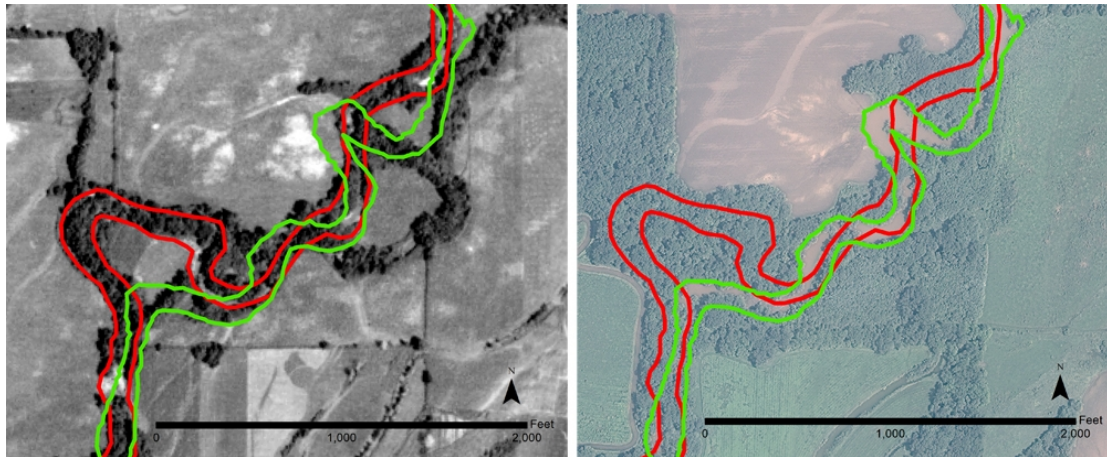
The student workers carefully cataloged areas of change, and noted the unique features of each. For example, though the largest single channel switch showed land still under cultivation in 2008 (Figure 3), many of the smaller cutoffs or meanders resulted in previously productive fields on the opposite bank being abandoned to woodland (Figure 4). The causes of the singularly large cut-off mentioned above stirred some debate amongst the geomorphologists. The shift did occur immediately downstream of the installation of an interstate highway bridge. Though some signs of possible channelization were noted in the 2008 imagery at this point, the relationship and chronology between highway construction and channel shift is unclear. Infrastructure installation may have led to changes in the river system, requiring intervention. But it is also possible this human-induced channelization was initiated by local landowners. It is worth noting that another shift in channel appears to be taking place upstream where a new state highway bridge has recently been constructed. Students are eager to look for signs of continuing change and explore issues of causality.





**Figure 3.**  
*Large Meander Cutoff Downstream from Highway Installation (Red Indicates 1938 River Banks, Green Indicates, 2008)*





**Figure 4.**

*Example of Farmland Abandoned Between 1938 (left) and 2008 (right)*

As of Spring 2012, work is ongoing to determine land ownership for the tracts bordering the river. Students are combing county archives for deed information. Of particular interest is whether any of the land migrating from one side of the channel to the other was subsequently sold or if there were any changes as to whom the land is legally ascribed as a direct result of the channel migration. A preliminary presentation to regional stakeholders garnered significant interest in the results. Additionally, student exploration of rural locales and interactions with county officials have broadened their understanding of the local environment and increased visibility for the university within the community.

Future plans include narrowing the dates for major changes and obtaining images for interim periods. More detailed quantification of land change rates will be explored. When landholders can be identified, interviews will be conducted to determine impact on personal and family farm productivity. A full, comprehensive report to the community, allowing students to participate with local interest groups, could also be extremely beneficial to all involved.

## Results and discussion

The benefits of this project, to date, are numerous. Students have learned new skills and become familiar with the work of their counterparts in the cooperating discipline. Connecting careful digitization procedures to physically-based outcomes added context and an appreciation of process for those involved in the GIS work. Not only did visualizing the change spark an interest in further understanding of the underlying geomorphology, it also helped to demonstrate the importance of accuracy in mapping and photogrammetric procedures. For the geologists involved, the ability to produce relevant information even when limited by field work constraints on in situ data collection were instructive. Students also engaged with the community and local landscape in a unique and purposeful manner, helping integrate their research experience with a deeper understanding of the characteristics and values of the community surrounding the university. The opportunity to broaden understanding in

a hands-on project with relevant goals and a manageable scale appears to benefit classroom-bound students across the board.

This cross-disciplinary experience also provided undergraduate students with the opportunity for professional development. The first undergraduate involved in the work was able to join faculty at the 2011 national GSA meeting in Minneapolis, her first professional meeting, to help present results. She has since gone on to success in graduate school and will be graduating with her master's degree in 2013. A second of the three students involved in the project has been accepted into grad school in geology beginning in the Fall of 2012. Successful undergraduate research endeavors are certainly valuable in preparing students for further graduate study, and an interdisciplinary component can be a catalyst for true academic growth.

Faculty, as well, has benefitted from this interdisciplinary work. The collaboration between geography and geology was welcomed within both the departmental administration and the campus' College of Sciences. The ability to provide an integrative and applied research experience helped raise the priority and productivity of the project. It also led to disciplinary cross-pollination in terms of conference attendance. The geographer involved helped present at a national geology meeting while the geologist co-presented on the academic value of this work at the Association of American Geographers conference in New York in 2012. The success of this initiative has convinced the parties to expand the project and seek outside funding for a more comprehensive study bringing academics of even more varied disciplinary variety into the working group.

## **Conclusion**

As attested to in the case study presented, engaging students and faculty in integrative and interdisciplinary investigations of applied problems has the potential to benefit all involved. Undergraduate students gain both practical and analytical experience, particularly beyond their narrower home discipline. Integrating classroom knowledge with purposeful, carefully-planned research is a growing priority at many institutions of higher education. Engaging these goals with clarity and intentionality benefits the research process in both theoretical and practical terms. The breadth of geography's scope, and its bridging position in the world of higher academics, offers fertile ground for such endeavours.

Interdisciplinary, integrative projects also expand collegiality and communications across departments. Faculty benefits from the expanded opportunity of research and outreach. Additionally, the positive outcomes provided to students should not be underestimated. Providing a deeper understanding of how disciplinary training fits into the broader scope of scientific exploration is a valuable and enriching experience for undergraduates. Opening new possibilities of communication with students in their own department and beyond prepares the candidates for a higher level of effectiveness in graduate school and/or the professional world. Opportunities for professional development, for students and faculty alike, multiply as the scope of research broadens.

Finally, the ability to deliver significant results to community stakeholders grounds the research process in a meaningful, experiential framework for students. Interacting with the community in applied research is a unique conduit for integrative, interdisciplinary investigation. The practical impacts of such inquiries deliver a relevance and immediacy that engages all participants. By drawing out lessons learned in a classroom setting and establishing inclusive, structured methods of real-world investigation, students, faculty and the community may engage in a process which delivers a useful, impactful experience for all.

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