Teaching Geographic Concepts Through Fieldwork and Competition

Joseph P. Hupy

Abstract
This article describes the benefits of combining field-based learning within the context of a competitive setting in the geography curriculum. Findings and data are presented based on experiences gathered from teaching an upper-level university geography course that combined geographic techniques and theory into a game of capture-the-flag. Students analyzed a variety of geospatial data sources, using ArcMap Geographic Information System software, to prepare a series of maps for the game. Students reported a first-time understanding of many geographic skills that were previously ambiguous to them when the material was presented in a different format, such as lectures and labs.

Key Words: *fieldwork, competition, geographic information systems, group learning, gaming*

Joseph P. Hupy is an assistant professor in the Department of Geography and Anthropology at the University of Wisconsin–Eau Claire in Eau Claire, Wisconsin, USA.

Introduction

If a university-level geography student is presented with the choice of either matriculating in a classroom-based lecture course or a course based upon fieldwork, the student will often choose the latter. The mere mention of the word *fieldwork* means getting out and studying the very spatial concepts upon which geographers have based their careers. The concept of geographers working in the field in not new, nor is it novel; geographers have a long history of field-based activities (Sauer 1956). Working in the field is not only an effective means to perform geographic research, but also teaches a multitude of geographic concepts (Pawson and Teather 2002). For these reasons fieldwork has been, and continues to be, a mainstay within the discipline of geography. Using fieldwork as an effective teaching tool in geography builds upon five essential geographic skills: (1) camaraderie; (2) collaboration and cooperation; (3) critical thinking in problem solving; (4) integration of geographic concepts; and (5) proper implementation and utilization of geographic tools and methods (Hupy *et al.* 2005).

Establishing a sense of camaraderie among students cannot be stressed enough. Once the students establish a sense of *us* as a class, the other four skills come to students much easier. A collective mentality among students brings about the realization that by cooperating and collaborating among themselves, the issue at hand will get solved much faster with teamwork (Simm and David 2002). Channeling that teamwork into a challenging field-based topic generates a great deal of critical thinking within the group to solve the problem at hand. A group that functions as a team will also collaborate with each other by delegating certain tasks to students who have the necessary skills to solve the particular problem assigned to them. Students will discuss the problem, incorporate previously learned geographic concepts into the problem, and evaluate how best those concepts relate to the problem. Once those concepts have been identified, students in a group with a sense of teamwork will decide what tools and methods will work best to address the problem (Healey and Matthews 1996).

Although the merits of fieldwork have been well established in the geographic literature, field-based learning does have its limitations (Haigh and Gold 1993; Kent and Gilbertson 1997; Pawson and Teather 2002). Every instructor who has worked in the field knows that planning a field trip or field excursion is not an easy task—it involves lots of planning and preparation (Warburton and Higgitt 1997). After all that preparation, it can be very frustrating to see students only going through the motions, doing only what is required of them (Jenkins 1994). To get more participation out of the students, the instructor can require completion of a formal report or the instructor might inform students that material from the field event will show up on a test or quiz. While these methods have been proven to get the students more involved, they also take the fun out of the activity, therefore leading many students to go through a set series of hoops just to pass the class with what they deem is an acceptable grade. When a gaming atmosphere is incorporated into a classroom activity, a competitive mentality is established among the students, and can often spark interest in what are commonly mundane classroom activities (Churchill and Liebowitz 1990; Paraskeva, Mysirlaki, and Papagianni 2010).

Based upon previous casual observations made during group-based competitive classroom activities, students enjoy team-involved competitive activities because the individual student has the option of either blending in, or standing out if they wish. If a student blends in with a group, it does not necessarily mean that particular student is engaged with copying from other students work and not contributing to the group. More often that particular student contributes in a manner that would not show if competing at an individual level. Those students with more of an outgoing personality enjoy group competition because they have the opportunity to exhibit their leadership skills. This blending of personalities into a team with a sense of purpose allows for a progressive, competitive learning environment. Students, whatever personality they may have, when pitted against their peers in such situations will enthusiastically take on projects in order to outcompete other teams and, in some cases, other team members involved in the project. Providing the students an opportunity to compete against each other as groups not only builds upon team-based learning, but also encourages a this involves me" attitude in the individual student (Warburton and Higgitt 1997). Involving a field element in this type of competition produces an ideal learning environment. This article discusses how fieldwork can be combined with competitive learning into a wide array of geography courses. Although the competitive learning activity described in this article is implemented within the format of a military geography course, the activity can easily be modified to fit within any field-based geography class.

Project Design and Methods

Game Rules and Structure

The childhood game of capture-the-flag provides an excellent means for geographers to insert fieldwork within a competitive learning environment. For those readers unfamiliar with the game and its variations, essentially two teams compete to capture the other team's flag and bring it back to where their own team flag resides. The necessity for navigation skills and a basic ability to assess terrain not only make this game excellent to teach the fundamentals of military geography, but the basic tenets of geography as well. Under normal circumstances, the game is played much akin to a game of tag, with individuals who get touched by opposite team members "out," until somehow "freed" by their own team. To simplify the game, and to make it more appealing to a university-level student, paintball markers can be utilized as a tagging device; if a team member is hit by a paintball, they are out of the game. Implementing the use of paintball markers raises safety concerns, and could be controversial among students who don't wish to engage in an activity they may regard as too violent for their nature. There is also a cost issue with paintball markers. Unless university or external funds can be obtained to purchase and maintain paintball markers, the interested instructor should consider renting the markers from a paintball course, which often rent these out for a reasonable fee. Therefore, use of paintball markers in this type of class project should be considered optional; the activity can easily be implemented without the use of such devices.

The instructor need not adhere to traditional capture-the-flag game rules. In the two semesters the military geography course was taught, the rules of the game were changed according to the size of the class and proximity to the site. When choosing a study site for a game of capture-the-flag, the instructor should look for a physically diverse landscape (Fig. 1). Study areas in the past were approximately one square mile, and were diverse enough to contain several streams, uplands, low lying wetlands, and a diverse array of vegetative covers. A study area of this size allows students to analyze an area with a diverse array of geographic variables, while still managing to allow students to play within an area that is not overwhelmingly large. The instructor also has the option of narrowing down the playing field on the day of the event if they feel the students are dealing with too large an area. In the two semesters of engaging in this event, the playing field was narrowed down significantly once students arrived at the study site. In each case, students were only made aware of the fact the playing field was reduced on the day of the event, otherwise students likely would have focused their analysis on the field of play.

In the first year the game was taught, the study site was fairly close, so the class of twelve was able to access the site easily. The class was divided into two teams of six students per team. One team was labeled offense, and the other defense. The defensive team had to establish a base with a flag in the center, and defend the flag from seizure by the offense. Defensive team members had the option of visiting the site of the game prior to the event and performing as much groundwork as possible to establish a defensive perimeter around their base. They also were able to use as many geographic tools and data sets available to them in order to determine where best to establish their base. Offensive team members, on the other hand, were not allowed to visit the site of the event until game day, and were limited to external, often Web-based, forms of geospatial data to help them best predict where the defense base might be located and how best to get there.

In the second instance the military geography course was taught, and the game implemented, gas prices were much higher and the study site was much further away. In this case, the class was divided once again into two teams, but there was no defensive home field advantage. Each team was provided with an aerial image that contained a polygon defining the area where the game was to be played out. Unlike the first game where the teams were allowed to pick where to put their flag, in this case the instructor provided the coordinates, Universal Transverse Mercator North American Datum 1983 (UTM NAD 83), where the team flag should be placed. Teams were responsible for

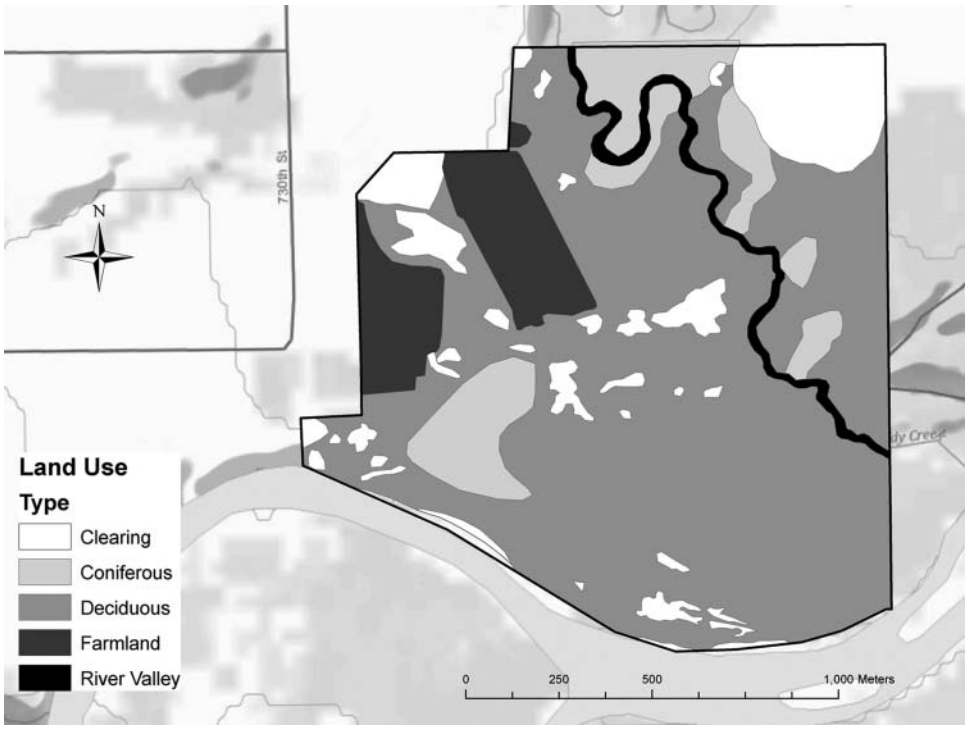

Figure 1. Study area boundary and land use for 2008 capture-the-flag match.

navigating to that location as quickly as possible to set up their flag, and any defensive fortifications, on the day of the event.

One full class period was designated solely to prepare the students for global positioning system (GPS) navigation using UTM coordinates prior to the actual capture- the-flag event. This type of preliminary training activity is strongly encouraged if the instructor is considering using GPS devices in a game of capture-the-flag. This activity was implemented based upon problems encountered the first time class was taught, when navigation errors led to instructor intervention in the field activity. Students often believe that because they are using GPS technology, the GPS will perform the navigation for them, but soon realize that GPS navigation in real time without the use of waypoints requires knowledge of using grid coordinates properly. In the GPS training class period, student teams of two were established, and each student was provided with a GPS receiver and a hand-held radio. The students were also issued a laminated map of the exercise area with a UTM grid on it. The instructor then split the teams up by telling one student to go to a predetermined coordinate location. The students then communicated via hand-held devices, with the student at the coordinate location guiding the other students towards the location. No landmark descriptions were allowed in the exchange between students, and there was a learning curve for some students to navigate in this manner. However, the students soon caught on, and by the end of the activity were finding each other quite rapidly, calling only the last three digits of the UTM coordinates. The students appreciated this learning activity, and often expressed they never really understood geographic coordinate systems until they engaged in the exercise. The students also liked the competitive atmosphere, and chatter could be heard over the radios over who was finding whom faster. Team members also quickly realized the benefits of an established communications system for an event like capture-the-flag, and quickly established secret radio channels, call signs, and constructed UTM coordinate-based maps of their future study site.

Geographic Skills and Data Sources

Once a study area is designated, the students can then begin gathering information on the study site from a variety of geospatial data sources such as digital elevation models (DEMs), Soil Survey Geographic Database (SSURGO), digital raster graphic (DRG) topographic maps, digital ortho quarter quads (DOQQs), and local climatic data records. Each team is asked to elect a leader to oversee construction of a preliminary report that provides various forms of geographic analysis within the study area. Once a group leader is established, the students are then told to create various smaller working groups who then focus on a component of the preliminary report. One group might do aerial image interpretation using the DOQQ imagery, while another squad engages in terrain analysis using the DEM, while yet another squad focuses on climate and weather reports. The team leader is in charge of working with these groups in order to integrate the information they collect. Although these groups can be designated by the instructor, it is in this author's opinion that small group designation is best left to the students as part of a team-building component within the activity. Student teams should be created, however, based on the amount and type of experience each student maintains. For example, some students may have advanced geographic information system (GIS) skills while others may have none or just introductory level GIS courses. To prevent a bias on team skill levels the instructor should have the students list their course background, and balance the teams accordingly.

Many geographic tools and principles are utilized by students during construction of the preliminary report.

Depending on the amount of GIS background the students have, the instructor may or may not wish to implement various exercises to get the students familiar with various forms of landscape analysis using a GIS. If the students have had GIS experience in the past, the best practice is to guide the students through the various forms of landscape analysis they wish to engage in, rather than hold them to a rigid set of predetermined outcomes. Allowing the students to perform the analysis they want and merely guide them helps to foster a competitive atmosphere, since one team will always insist they are outdoing the other team in terms of their predictive analysis.

Once provided with all the data sets, the students will at first be confused as to what to do with them, and may not know how to use the information to their advantage. Here, once again, the instructor should guide the students, and not tell them what to create. For example, if the students have had past GIS experience, they are likely familiar with DEMs and DOQQs, or some other form of high resolution aerial imagery. They also likely engaged in some type of prior analysis with these data sets, yet may not know how to apply what they have previously learned. When faced with such circumstances, the instructor should ask the students what information each of these data sets can provide, and then ask the students what their objective is—to defeat the opposing team. The students could be asked nudging question such as: what types of vegetation are easier to move through than others; what advantages do trails hold for movement rather than dense forest; how would these trails present a disadvantage in terms of possible ambush opportunities for the enemy; how would wetlands, streams, and rivers hinder movement; what does steep terrain mean for movement; how would a steep slope as opposed to a gentle slope influence the defensive characteristics of a location? Questions such as these move the students into the creative sphere, and groups will begin to use the GIS beyond that of mere computer cartography, and what it is truly meant for—as a tool for geographic analysis. For example, one form of GIS analysis that students often struggle with in the GIS classroom is least-cost-path determination. Least-cost-path involves the use of several data sets, and a reclassification procedure that places a value in terms of movement difficulty across pixels in a raster data set. Areas in thick vegetation or a steep slope are more difficult to move across than via a trail, or gentle terrain. The more difficult the surface is to move across, the higher the number it is assigned. In certain cases, features such as rivers or cliffs are assigned such a high number that they are considered barriers for any type of movement across them. Placing weighted values on pixels is a concept that students often have difficulty with, and when that concept is combined with something as complex as least-cost-path analysis, the students often have no idea when such a practice would be used. However, once students apply their own data to achieve their own outcome, the concept has a higher likelihood of student cognitive understanding. Students preparing for this event often went beyond the mere use of DEMs and DOQQs in their analysis, and requested assistance with assigning number weights to SSURGO data in order to construct an even more accurate least-cost-path surface map in preparation for the field event.

Once the students are engaged with construction of the preliminary report, the instructor will find him/herself guiding the students towards what is feasible, both financially and temporally. They will work very hard generating a report for an event that they believe is the high point of the semester. Many of their products will likely not prove fruitful during the capture-the-flag exercise, and students may express dismay toward the wasted effort in making some of the products, especially if they are on the losing team. The instructor should treat these comments as a teachable moment, asking students how those products might be done differently to achieve better future results. On the day of the event, the instructor should let the students play the game as it unfolds, and only intervene if entirely necessary. Team plans should be expected to fall short of the mark, or disintegrate entirely. The instructor needs to take note that team shortcomings will be addressed in the second half of the semester.

Although the game of capture-the-flag is the main focus of this research activity, students should be reminded that analysis continues following the event. After playing the game students should be engaged during the remainder of the semester with compilation of a final report that builds upon their preliminary analysis, along with a post-event analysis that reports successful and failed strategies of both teams. Students once again work within their assigned small groups, with the elected leader overseeing compilation of the final report. Although each team turns in a group report, the instructor may want to ask each student to write a personal small report (2–3 pages) detailing what each group member was assigned to do and what they contributed to the group effort. By including an individual report of accountability into the team report, the possibility of freeloaders is reduced because it makes students accountable for areas of the team report that were lacking, and open to point deductions (Simm and David 2002). Due to the competitive nature of this activity, however, students heavily police themselves in this regard. By the end of the semester students will have developed a sense of camaraderie and no student will want to let down his or her teammates, leading to a final team report that instills a sense of accomplishment and involvement for each team member.

Conclusion

Using competition within a field setting proves an excellent means of teaching geographic tools, techniques, and principles. While the context of this course was taught based on the premises of military geography, and a great deal of military spatial theory was employed within the final project, this course could easily be taught outside that realm. Any instructor involved with teaching a field-methods-based class could implement some variation of

this activity within the structure of the course design. The competitive nature of this activity allows students to learn core geographic concepts such as map creation, map interpretation, terrain analysis, navigation methods, coordinate systems, and aerial image interpretation. Students are also introduced to various forms of geospatial technology that they will likely encounter when they enter their post-undergraduate careers.

If there is any one concept the instructor should take into teaching this activity, it is to guide students in their pursuits, not tell them what products to create. Telling the students what to create based upon a provided data set will merely recreate what they have experienced in previous courses, and destroy the competitive learning environment. It is in this type of learning environment that previously taught concepts that did not resonate with students finally register in their minds. In their course evaluations, students repeatedly mentioned how the forced hands-on learning set the course apart from previous courses in their academic career. The students also made frequent mention of feeling overwhelmed at the beginning of the course, and the heavy workload involved, but how it was all worth it in the end. When the students are placed on a team, with the prospect of victory for those who work harder, the students develop a direct connection with the learning process, and it is the students themselves making choices as to which tools and methods to use. Combining teamwork with competition also presents minimal problems with individuals in the class not pulling their own weight and latching on to efforts of the greater group. Adding the individual report into the final team report also establishes accountability for each class member.

Of the problems noted by the instructor throughout the duration of the project, perhaps the most noteworthy is the amount of time required both in project design and implementation. Although the goal of such a final project is minimal instructor intervention, students inevitably have questions, and there are certain tasks the students cannot be expected to perform at the undergraduate level. One example would be site selection. For such a project to take place, the instructor needs to spend a great deal of time locating a large parcel of land appropriate for such an activity. Even when a suitable parcel is located, state and local rules may prevent such activities; possible restrictions and permissions may need to be identified. If any reader is considering such a project, allow ample time for project design. Another problem with this type of activity is the cost involved. In an era of increasing field trip expense cuts (Haigh and Gold 1993), do not expect funding for an activity such as this to come easily. Eliminating paintball markers from the activity, or renting out the markers from a local course, may be a way for students to engage in this type of activity, although there are still costs involved with visiting the study area.

Other future improvements could involve making several trips to the study area, each trip emphasizing a different geographic tool or method. Students could engage in a series of small events that culminate into a larger end of the semester event. However, once again, travel is restrained by ever increasing field trip costs in a time of increasing cuts to the university environment. There is no one right way to engage in this sort of activity. The most important aspects of an activity such as this are to (1) let the students learn on their own, and (2) foster a sense of camaraderie within a (3) competitive atmosphere. In sum, combining fieldwork with this form of competition has many possible variations, and this activity has shown it to be a very effective means of instruction.

References

Churchill, R. R., and R. Liebowitz. 1990. Spatial conflict and conflict resolution: A classroom. *Journal of Geography in Higher Education* 14 (2): 151–156.

Haigh, M., and J. Gold. 1993. The problems with fieldwork: A group-based approach. *Journal of Geography in Higher Education* 17 (1): 21–32.

Healey, M., and H. Matthews. 1996. Learning in small groups in university geography courses: Designing a core module around group. *Journal of Geography in Higher Education* 20 (2): 167–180.

Hupy, J. P., S. P. Aldrich, R. J. Schaetzl, P. Varnakovida, E. Y. Arima, J. R. Bookout, N. Wiangwang, A. L. Campos, and K. P. McKnight. 2005. Mapping soils, vegetation, and landforms: An integrative physical geography field experience. *Professional Geographer* 57 (3): 438–451.

Jenkins, A. 1994. Thirteen ways of doing fieldwork with large classes/more students. *Journal of Geography in Higher Education* 18 (2): 143–155.

Kent, M., and D. Gilbertson. 1997. Fieldwork in geography teaching. *Journal of Geography in Higher Education* 21 (3): 313–332.

Paraskeva, F., S. Mysirlaki, and A. Papagianni. 2010. Multiplayer online games as educational tools: Facing new challenges in learning. *Computers and Education* 54 (2): 498–505.

Pawson, E., and K. Teather. 2002. "Geographical Expeditions": Assessing the benefits of a student-driven fieldwork method. *Journal of Geography in Higher Education* 26 (3): 275–289.

Sauer, C. O. 1956. The agency of man on the earth. In *Man's Role in Changing the Face of the Earth*, ed. W. L. Thomas Jr., pp. 49–69. Chicago: University of Chicago Press.

Simm, D. J., and C. David. 2002. Effective teaching of research design in physical geography: A case study. *Journal of Geography in Higher Education* 26 (2): 169–180.

Warburton, J., and M. Higgitt. 1997. Improving the preparation for fieldwork with "IT": Two. *Journal of Geography in Higher Education* 21 (3): 333–347.