Inquiry-Guided Learning Through Collaborative Research

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Introduction

I (GRH) got involved in inquiry-guided learning for somewhat selfish reasons – it was a scheme to carry out collaborative research without funding and to gain simultaneous credit for teaching and research. At the time, I had no idea there was a name for this style of teaching and I certainly didn’t know it was something educators considered cutting-edge.

During my first semester as a newly minted landscape and conservation ecologist at NC State University, forest economist Bob Abt joined me to offer an elective graduate course called The Ecology and Economics of Clearcutting (Hess et al. 1998). The course objective was to research the issues surrounding the forest clearcutting controversy and produce a written, publishable analysis and synthesis of the competing perspectives. The students would have a real-world collaborative research experience, learn along with us, and gain authorship on a peer-reviewed publication. In addition to the publication, Bob and I would obtain the information we needed to write proposals for further research without having to plow through all of the literature ourselves. Indeed, it seemed the epitome of a synergistic, win-win scenario (Covey 1989). Things didn’t work out quite as we expected – more on that later.

Three attempts later, I have a much better idea of what I’m trying to do in these courses, how to market them, and how to make them work (Box 1, Figure 1). In the range of inquiry-guided learning applications, from a single, brief activity during a course, my collaborative research courses are at the opposite extreme – completely built on inquiry.
In what follows, I describe briefly the key ingredients for such a course and provide students’ comments about the courses (indented, in italics).

I liked the approach of coming into the experience with a blank slate and creating something from the ground up. It is really helpful in stimulating original thinking on the subject. Many times, one is given so much background information on a subject or a textbook about the subject and this constrains the original thinking process. I liked the brainstorming aspects of the group and I thought it was good how the instructor acted more as a facilitator than as a dictator.
— Measuring Suburban Sprawl

I’m now looking forward to a lifetime of collaborative projects.
— Surrogate Species Planning

Ingredient 1: Technical and Professional Development Objectives

A collaborative research course has two types of objectives: technical and professional development (Box 2). The technical objectives relate to the subject and intended product of the research, and are often what initially attract student interest. The professional development objectives relate to the process of carrying out collaborative research. Students must understand that they will be working on a research question for which the answer is unknown, and that they will become part of an interdependent, collaborative team seeking new knowledge. If they are looking for textbook answers, they should not sign up.

The most attractive components of the course [Surrogate Species Planning] objectives were the opportunities to work on a collaborative project, to wrestle with a topic with direct applications in conservation ecology, and to produce a potentially significant and broad reaching publication in a short period of time. This course offered a chance to gain skills that will be important in my career, but are not provided through dissertation research or more traditional classes: skills in collaboration, cooperation, conflict resolution, compromise, and group responsibility. I knew next to nothing about the course topic when I began the course – it was the nature rather than the subject of the course that attracted me.
— Surrogate Species Planning

<< Insert Box 2 near here >>
Ingredient 2: Real-World, Controversial Topic

The technical objective should relate to a real-world, controversial topic that will interest students and the instructor (Box 3). By “real-world topic” I mean one that is making headlines, at least in the research community. The course topics I have chosen were all current, controversial topics that I wanted to learn more about and that interested students: The Ecology and Economics of Clearcutting (1996), Measuring Suburban Sprawl (2001), Focal Species Conservation Planning (2002), and Surrogate Species Planning (2003). Controversy is a key ingredient to attracting students and ensuring that there will be a diversity of stimulating perspectives. Controversy helps break the ice at the beginning of the course by making it easy to brainstorm various points of view, provides a starting point for quickly engaging the literature or splitting up the work, and ensures that the research product will be of interest to a broad audience.

The Surrogate Species Planning course was constructed around two technical objectives: (1) a detailed literature review of surrogate species planning approaches and (2) a comparison of surrogate to other conservation planning techniques. The effectiveness of surrogate species approaches is strongly debated in the conservation community, which ensured interest in the project among conservation ecologists and planners. The availability of comparative data from the region surrounding North Carolina State University and the participation of people involved in local on-going conservation efforts also gave this project a heightened sense of immediacy.

In Measuring Suburban Sprawl, the technical objective was to develop quantitative measures of suburban sprawl. This objective required that we first define sprawl operationally, something that had not been done in a systematic manner despite the many opinions about sprawl and how it affects people and the environment. With this in mind, the team was able to enter the literature and controversy with a strong focus and sense of mission.

Because it was a real problem it was much more complex and challenging than any simulated class exercise – but it also provided a much better motivation to put in the extra effort and it provided a much greater sense of accomplishment at the end.
— Surrogate Species Planning

It was great that the course dealt with a real-world problem and had the potential to offer new insights into that problem; this was much more fulfilling than the usual academic exercise.
— Measuring Suburban Sprawl

This was such a wonderful opportunity to work on a project that can cause some ripples not only in the research community and hopefully trickle down to practicing planners/managers, but also to work with real datasets for the surrounding area that can be directly applied to conservation efforts being presently made in the field.
Dealing with a real problem made the project have more purpose for me and also led me to be more concerned with doing a good job since others outside the class might actually be interested in the outcome.

— Focal Species Conservation Planning

Ingredient 3: Real-World Product

The technical and professional development objectives are inextricably linked with the product of the course. Collaborative research is about organizing the efforts of people with diverse skills to produce results. Technical objectives define the subject and nature of the product, while the process of creating the product determines professional development objectives.

A collaborative research course should have a well-defined, real-world product (Box 3). By “real-world product” I mean something that will be used or published well beyond the classroom. In the case of the Surrogate Species Planning course, two peer-reviewed publications were defined as the products in the course announcement (Figure 1; Favreau et al. 2003; Hess et al. 2003). The Focal Species Conservation team produced a poster displayed at a professional meeting and data used by conservation planners (Hess et al. 2002). The Measuring Suburban Sprawl team produced a peer-edited publication in a planning journal (Hess et al. 2001). Other possible products might include a database needed by a non-profit organization or government agency, a working simulation model for use in future analyses, or a detailed review of policy options for decision-makers. Depending on the product and the intended user of the product, the course might take on service-learning attributes (Eyler et al. 2001; NSLC 2003).

The product can be established before the course begins, or by the students as the course progresses. For recruiting students, it seems best to have an enticing product defined at the outset. Flexibility is important, however, because findings along the way might require changes to the products.

The real world product was important as an initial attraction to the course. Having that product well-defined in the course description allowed me to evaluate the time commitment that would be required for this course and the skills that I would contribute and gain. However, the final product must also be flexible if we are truly equals. Our literature review turned into an essay publication as the nature of the controversy surrounding our topic became clear. Also, the well-defined topic represented the instructor’s vision for the class and as equal collaborators we had some different opinions. As a consequence, several new products
were added (such as interviews of practitioners) and several were modified.

— Surrogate Species Planning

**Ingredient 4: Strong Collaborators**

Failure to select an appropriate mixture of students resulted in the failure of my first attempt at collaborative research in *The Ecology and Economics of Clearcutting*. Bob Abt and I envisioned a group of experienced and highly motivated students, drawn from multiple disciplines, collaborating with us as peers. We needed students with solid technical skills and knowledge, who we could organize into an effective, collaborative team. Unfortunately, we did little to ensure that the students who registered for the course met these criteria. Most of the students who registered did not have the technical background to contribute significantly to new research, nor were they ready for the kind of collaboration we envisioned. The course quickly acquired a traditional structure, with reading assignments and papers to be written for the instructors. Thus, although the students improved their technical knowledge, they did not advance research in the way Bob and I had envisioned and we did not create the desired research products. The students also did not gain the collaborative research experience we intended.

Students must be prepared to work in an interdependent manner to hone the research question(s) and find solutions (Box 4). I have found telephone or face-to-face conversation with interested students the most effective way to make this clear. Stating explicitly that I do not know the answer to the technical question being posed, but that we will work as a team to find it, often drives the point home.

I have raised the selection bar in each offering since the *Clearcutting* course, and the results keep improving. For the *Surrogate Species Planning* course, I required students to submit a written application describing their qualifications and interest. I also recruited specific students that I knew were capable and interested in the subject. One might ask faculty colleagues to recommend students, and send course announcements (e.g., Figure 1) to appropriate departments. Selecting the right students is important enough to spend the time recruiting, and I am convinced that a combination of recruiting and written application is the right approach.

I have found that the best candidates are students who have completed at least a year of doctoral work. These students tend to have some well-developed technical skills and a good knowledge base on which to build. Doctoral students – at least from my experiences – are also more likely than masters students to be considering careers in research and are thus more open to professional development activities aimed at improving their collaborative research skills. Students earlier in their careers tend to lack the knowledge base to make substantive and innovative contributions. Of course, there
are always exceptions, which is one reason that a well-defined selection process is important.

*The experience of planning and performing research with a fairly large group of people with only limited time was invaluable.*

— Measuring Suburban Sprawl

Our group of students worked remarkably well together. Our skills complemented one another, so each naturally took leadership of a different area of the project. Also, from the first day when each arrived having completed all the reading and prepared for discussion, there was a high level of mutual trust. We each knew that the others were giving this project the highest priority and were giving an effort beyond expectations. Discussions were open and highly productive. Although our styles of working and organizing were frequently different, we were able to integrate the strengths from our diverse approaches to build a better product. At times, working together was frustrating as we sought to find a compromise among our diverse opinions and methods, but the resulting products were much stronger for having emerged out of this struggle.

— Surrogate Species Planning

### Ingredient 5: A Common Foundation

A semester is not a very long time, so some structure is needed at the beginning of the course to quickly provide a common foundation and to ignite the collaborative process (Box 5). There are a number of ways to accomplish this, including brainstorming sessions and assigned readings.

In the *Measuring Suburban Sprawl* course I started with a brainstorming session in which each team member was given a pad of sticky notes and asked to write as many ideas as they could about defining sprawl, one idea per sheet. We went around the room and posted the notes on the wall, attempting to group what seemed to be similar ideas. This proved a very effective way to get all the perspectives out into the open, and the students were surprised by the variety of ideas. This session invested the team in the process and provided the organizational spark for our efforts.

In both conservation planning courses, I assigned a sequence of readings with discussion questions to be completed for the first class meeting. These readings acquainted team members with the technical issues. Discussion revealed diverse perspectives and generated constructive controversy. These discussions led to a clearer definition of the research question, a plan of action crafted by the team, and consequent transfer of ownership to the team.

In the *Surrogate Species Planning* course I also did some “community building” before the course started, in addition to an initial reading assignment and brainstorming session.
I established an electronic mail list server and asked each of the team members to introduce themselves by e-mail with a brief description of their background and interests. There was some side chatter on the list server as well and team members began to get comfortable with one another. This relieved the anxiety some people feel when joining new research teams.

The readings provided a common foundation and introduction to the topic. Since most of us knew little about the topic (due to our interest in the process rather than the topic) this was important. The brainstorming sessions were very helpful to build community – all ideas were welcome and somehow fitted into the growing web of ideas on the whiteboard.

— Surrogate Species Planning

Ingredient 6: Open Channels of Communication

Team members must reach consensus on research direction, the nature of the final product, division of labor, schedules, milestones, and other issues that arise. Well-defined channels of communication among team members must be established, if the effort is to succeed. As team leader, the instructor must be prepared to facilitate communication and mediate conflict.

I make many methods of communication available to team members, and all are used heavily (Box 6). Regular face-to-face meetings are perhaps most important. This is a lesson learned during the Clearcutting course, which was initially to be conducted largely by internet (Hess et al. 1998). After a few weeks, team members voiced a strong desire for personal contact to help them develop the sense of community critical to fruitful collaboration. Face-to-face interaction is also highly valued for brainstorming and bringing complex technical issues to closure. Since my experience in the Clearcutting course, I have always scheduled weekly meetings.

Regular sit-down meetings are essential—I think that some people “collaborate” on projects with few meetings along the way. E-mail communication, electronic exchange of files, etc., is fine, but sitting down and hashing things out is just as important.

— Surrogate Species Planning

Having never participated in collaborative research before, it was helpful to have some direction in the process of planning the project.

— Focal Species Conservation Planning

<< Insert Box 5 near here >>

<< Insert Box 6 near here >>
Mix Well and Get out of the Way!

As an instructor, one of the challenges to offering a course like this is that you never quite know what’s going to happen. I start each course with a vision of how I expect things to go and resist the urge to push things in that direction. After all, a key goal is to get students to act as peers, which means you must treat them as peers and avoid the temptation to wield the power of an instructor by making unilateral decisions and manipulating the outcome. As long as the students have been selected carefully (Box 4), the role of facilitator is most appropriate for the instructor – someone who asks penetrating questions, removes obstacles, and creates opportunities. The team develops a very strong sense of ownership for the research and expects to have a say in its ultimate direction. The product is more than something to be submitted to the instructor at the end of the semester – it’s real and the students care deeply about how it turns out.

Flexibility is essential. In the Surrogate Species Planning course, my initial vision included publishing a literature review on the subject. As we became more familiar with the literature, the team decided that an essay describing the paralysis caused by the current debate, highlighting the lack of research data on the topic, and suggesting ways to move forward would be of more value to the conservation community than yet another literature review. So the team moved in that direction and began contacting other researchers by e-mail and telephone to get their perspective on the issue. The excitement generated by this process fueled the team, especially as the outside researchers showed enthusiasm for the direction we were taking. It was a very empowering and enriching process for the entire team – far better than pulling rank and insisting on following my original vision. (Of course, pulling rank might be necessary from time to time with a team that is not as technically strong and eager to collaborate as this team was.)

Working on a controversial real-world problem gave our work an urgency and immediacy that is never encountered in regular classes. We were motivated to put in much more time and effort. When interacting with the broader conservation research and management community we were encouraged by the broad support and excitement prompted by our project.

— Surrogate Species Planning

There were three areas where your leadership and guidance were particularly important:

1) Frequently asking, “Is this feasible?” to help keep the project from growing beyond what we could accomplish.
2) Frequently asking, “Whom are we addressing?” to help ensure that our writing / product had a clear direction.
3) Facilitating communication with a broader audience by inviting people in, emailing introductions, and helping set up interviews that we as mere students might not have gained alone.

Of course, as the work progressed, we each started doing these things on our own which supplied good evidence that we were developing some important professional skills.
Is It Working?

In short, “Yes!” During the last session of the *Surrogate Species Planning* course, the students and I participated in a focus group discussion about the course led by Dr. Douglas Wellman of North Carolina State University’s Faculty Center for Teaching and learning. Students immediately focused on the professional development issues in answer to the first question of the discussion, “What was the most important thing you learned in this course?” They highlighted the value of working on a real problem, learning how to collaborate with peers, creating a tangible product, and beginning to network with other professionals beyond our university. One student commented that she joined the course for the professional development aspects and would not have participated had it been a lecture or readings course.

During the summer of 2003, I surveyed students who participated in three of my collaborative research courses: *Measuring Suburban Sprawl*, *Focal Species Conservation Planning*, and *Surrogate Species Planning*. The quantitative results and associated written comments (many of the quotes presented in this chapter) make it clear that students valued these courses primarily for the emphasis on collaborating to address a real-world problem. In written and verbal comments, students noted consequent increased levels of interest, motivation, ownership, and accomplishment. Written comments also revealed that students consciously focused on skills they were not able to hone in other courses – those dealing with collaboration and interdependence.

*This course is one of the first times where I’ve sat down with a group of researchers and really examined the greater implications of the completed analysis/research. Since I am now working on a collaborative project with broad implication, I’m glad to have the preparation.*

— Surrogate Species Planning

*[Improving interpersonal communication skills] was one of the most positive aspects of the course. Most courses do not incorporate communication among students and that was what this course was about.*

— Focal Species Conservation Planning

*I especially valued the chance to collaborate with people from diverse backgrounds and disciplines. This type of class is how I expected all my doctoral level classes to be – but unfortunately it was the only one to offer this opportunity.*

— Surrogate Species Planning
Future Plans

In the Surrogate Species Planning course, I was more explicit about professional development than I had ever been before. I included several readings and assignments about collaboration and team development. This seems a good direction, as it spotlights concepts that might otherwise go unnoticed. In future offerings, I will tune the explicit focus on professional development to ensure that it is in concert with the technical objectives and products. I will experiment with different readings and perhaps assigning more team leadership roles to the students. Depending on the technical objectives, some attention to facilitation and conflict resolution might be appropriate. Yet, the focus on professional skills cannot become so intrusive as to dominate the hands-on collaborative research work, which is clearly what the students value most.

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Citations

Focal Species Approach. Poster presented at the International Association of Landscape Ecology Conference, Lincoln, Nebraska.


Box 1

Six Key Ingredients for a Collaborative Research Course

The essence of the approach is on-the-job-training: build a small team of advanced graduate students and treat them as peers in a collaborative research project. Think of it and carry it out as you would a research project with fellow faculty, with your role being that of team leader. To make it work, mix six key ingredients and then get out of the way as the team takes ownership.

1. technical and professional development objectives
2. real-world, controversial topic
3. real-world product
4. strong collaborators
5. a common foundation
6. open channels of communication
Box 2

Ingredient 1: Technical and Professional Development Objectives

A collaborative research course has technical (T) and professional development (P) objectives, both for the students and the instructor.

Objectives for students

In the natural resources, most graduate work tends to be undertaken by individuals, whereas teams often solve complex problems in a professional environment. Graduate students do not experience this often enough.

» learn the technical subject matter (T)
» participate in collaborative research (P)
» planning and organizing to perform collaborative research (P)
» chance to work on a real-world problem (P,T)
» exposure to diverse perspectives on a problem (P)
» experience the publication peer review process (P)
» develop publication or presentation other than thesis work. (P,T)
» improve writing skills (P)
» improve presentation skills (P)
» improve interpersonal communication skills (P)
» develop leadership skills (P)

My objectives as an instructor

Use a teaching approach that allows one to simultaneously teach and perform useful research.

» work with students on a research project in a team environment (P)
» work with students from a variety of disciplines and backgrounds (P)
» develop leadership skills (P)
» broaden perspectives (P,T)
» learn new technical material (T)
» do research without writing grants (T)
» publish new research (P,T)
Box 3

Ingredients 2 & 3: Real-world Research
Topic and Product

The research topic should be one …

» that the instructor wants to learn more about
» that will excite the interest of students
» is complex and involves multiple disciplines
» is current and in the headlines
» is controversial
» for which data are readily available (unless collecting data is the objective)

The research product should be …

» of value beyond the classroom
» manageable within the time constraints of the course (although submitting and revising publications might take a bit longer)
» flexible, to allow for modification based on discoveries during the course
Box 4

Ingredient 4: Strong Collaborators

When selecting students, think about building a strong research team. Some of these traits are hard to measure without prior experience with the student, which is why effective recruiting strategies are important.

» well-developed technical skill in at least one subject area needed to address the research question(s)
» self-starters – highly motivated
» creativity
» enthusiasm about the technical subject matter
» willingness to speak out, even with minority opinions
» willingness to hear out and consider diverse viewpoints
» indications that the student will be a good collaborator, such as knowledge of how the student has done in past team assignments
» indications of leadership ability
Box 5

Ingredient 5: A Common Foundation

A common foundation must be established early in the course. When establishing a common foundation, the team should …

» develop a common knowledge base
» define the framework of the controversy
» become excited about the topic, product, and process
» take ownership of the process and product
» refine the vision of the product, considering the amount of work to be done and the time and resources available
» reach consensus on an initial plan and timeline for completing the work
Box 6

Ingredient 6: Open Channels of Communication

Communication among team members is critical. Multiple channels of communication should be available.

» Regular face-to-face meetings. Weekly is probably enough, with ad-hoc meetings as needed. Minutes should be taken and distributed to all team members – this can be a rotating assignment. At some points during the course, more or less frequent meetings might be appropriate.

» An e-mail list or list server so that team members can send questions and ideas to all other team members.

» A contact page with e-mail addresses and telephone numbers of all team members.

» A web site with up-to-date work schedules, milestones, readings, drafts of documents in production, meeting agendas, meeting minutes, action items, and so forth.
Figure 1. Course announcement for *Surrogate Species Planning*. Note how the announcement incorporates many of the key ingredients: technical objectives, a real-world topic, real-world products, and a method for selecting strong collaborators.

**Surrogate Species Planning (NR 595E)**
George R. Hess, Forestry Department — 3 Credits S/U — Tu 4:10-7PM
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Surrogate species approaches to planning wildlife conservation networks — including umbrella, flagship, keystone, and focal species — reduce data requirements by limiting conservation and landscape planning activities to a small number of species. The central concept is that habitat protected for surrogate species will support many other species.

**Objectives**

Carry out original research and co-author two peer-reviewed papers:

(1) *The Surrogate Species Conundrum* — a detailed literature review.

(2) *Pick a Card* — compare three planning approaches in the Triangle: focal species, expert opinion, inventories.

**Joining the Team**

Enrollment is limited to 5 students, by application. For more information and to apply, please visit courses.ncsu.edu/nr595e/common

Apply by 2002 Dec 6. Final decision on participants will be made by 2002 Dec 13.