Problem-Based Learning in a Natural Resources Conservation and Management Curriculum: A Capstone Course

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ABSTRACT

Students trained in natural resources often lack experience integrating knowledge in ecology, sociology, economics, and other disciplines. We designed a 3-credit capstone course for Natural Resource Conservation and Management students that explicitly teaches integration of disciplinary knowledge using an interest-based approach to natural resource issues. The instructor chooses a current, high profile issue of local or regional significance that involves multiple stakeholders, lends itself to an interest-based approach, has an undetermined outcome, is both concrete and complex, and is tractable within a single semester. The goal of the course is to identify key stakeholders and determine the interests that underlie stated positions, using this information to develop approaches to resolving conflict that are amenable to a broad group of stakeholders. Two of the issues we have examined in 6 yr of teaching this course are (i) the introduction of elk (Cervus elaphus) to eastern Kentucky, and (ii) the revision of the Daniel Boone National Forest Land and Management Plan. Both topics required students to apply ecological understanding in a sociopolitical context to the development of recommendations, which were communicated through a final report to key stakeholders. We create a totally active learning environment, where the trajectory of the semester project is student driven with instructor guidance. Methods used by the students include primary data collection, key informant interviews, and internet and library searches. This course has been well received by students and stakeholders, and serves as a model for capstone courses in the University of Kentucky College of Agriculture.

In recognition of the potential for a problem-based course in natural resource issues to emphasize an integrative approach to problem solving while enhancing learning, we developed a senior capstone course for Natural Resource Conservation and Management majors at the University of Kentucky. Capstone courses are designed to serve as the culminating course for individual college curricula. The course we have designed fosters the development of skills in teamwork, interest-based problem solving, and the integration of disciplinary knowledge acquired previously through primarily traditional courses. A single, current natural resource issue serves as the focus for the one-semester course. Six years of development and implementation have led to a very successful course outcome, and one that serves as a model within the College of Agriculture for capstone courses in other curricula. In this paper we describe the course approach, identify and explain the key elements for success, and give two examples of issues we have used successfully. In addition, we describe the potential pitfalls of this teaching and learning approach, and provide suggestions for avoiding these.

COURSE GOALS AND APPROACH

The purpose of this 3-credit course, taught in the final spring semester of the senior year, is to immerse the students in a complex natural resource issue that requires them to integrate prior knowledge while seeking positive management alternatives and approaches. We take an interest-based approach to problem solving as described below. Six objectives contribute to this purpose:

1. To provide students with the opportunity to develop creative problem-solving skills
2. To foster an interest-based perspective (see below)
3. To develop the ability to work with people from diverse backgrounds and differing values
4. To apply integrative thinking to a strong natural and social science knowledge base
5. To develop team working skills
6. To further develop and practice communication skills

The students are expected to function professionally in this course, both in their interactions with group members and also outside the university. Attaining these objectives comprises the course content. Focus on a specific issue for the course each year provides the tool for addressing the course content.

Interest-Based Approach

Students address a current natural resource issue using an interest-based approach (Fisher et al., 1991). The concept

Abbreviations: OHV, off highway vehicle; KDFWR, Kentucky Department of Fish and Wildlife Resources; RMEF, Rocky Mountain Elk Foundation; USFS, U.S. Forest Service.

underlying this approach is that interested parties (stakeholders) holding competing positions may contribute positively or negatively to the resolution of natural resource issues. The goal of interest-based problem solving is to separate the positions (a priori preferred outcomes), from interests (the underlying values, needs, and concerns that inform the positions). Focus on positions can paralyze a process, potentially rendering a conflict intractable, whereas focus on interests can move a process forward. When a state or federal agency is responsible for managing an issue it is often difficult for the agency personnel to step outside the process sufficiently to develop an interest-based approach because they are also stakeholders. The role of the students in this class is to maintain an unbiased, objective approach to the issue, and seek the shared interests that often underlie stated positions. This requires the students to identify key stakeholders, and to determine, through multiple research approaches, the positions and interests of each. The students then use this information to develop creative approaches that can be used to build consensus and resolution. In this role, the students become mediators in conflict resolution.

This approach is very effective as a teaching tool for several reasons. First, it charges students with the responsibility of being the only group working on the issue that is not a stakeholder. For the students to be effective in this role, they must suspend their own values relative to the issue. This is good experience for students who, as natural resource professionals, will likely need to understand the perspectives of people with divergent viewpoints. Second, this approach requires the students to gather different types of data (including economic, sociological, and biological), using a variety of techniques and sources (including library and internet reviews, interviews of stakeholders and experts, and in some years, collection of primary biological data). Third, the students quickly understand the importance of the issue to each of the stakeholders, and this gives them a sense of the importance of their work to those affected by the issue. Finally, through this approach the students become intimately acquainted with the complexity of natural resource issues, which includes regulatory constraints and human dimensions in addition to scientific and technical considerations.

Criteria for a Successful Topic

The choice of a topic is the most critical element of a successful course. The topic is chosen in advance of the semester to allow the instructor to develop sufficient background knowledge to assess the likelihood of success, and to provide the students with ample information initially to address the issue substantively in only one semester. We have developed the following criteria to use in identifying a topic that has a strong likelihood for success.

High Profile. The topic must be timely and high profile locally or regionally. Choosing a topic that meets this criterion ensures the existence of a primary stakeholder with an interest in the findings of the class, which helps the students to attach a sense of importance to their work. Members of the managing stakeholder group also provide an audience of professionals for the final class presentation. Identifying additional stakeholders is facilitated by choosing a current and high profile issue because many of them will have identified themselves through media coverage of the issue.

Multiple Stakeholders. The issue must include multiple stakeholders, with widely differing positions and interests. The existence of conflicting positions adds greatly to the richness of the topic, and provides essential counterpoint to the identification of underlying interests.

Interest-Based Approach. The issue must be responsive to the development of an interest-based approach. While it is difficult to imagine a natural resource management issue that couldn’t benefit from identification of the key stakeholders and a deeper understanding of the interests underlying their positions, it is important to be able to identify this potential a priori.

Undetermined Outcome. The outcome of the conflict must not be predetermined. The issue must be current, but there also must be uncertainty in the outcome, or at least the potential for modification.

Specific Focus. The issue must not be too diffuse. A managing agency as primary decision-maker works well. State and federal agencies are often very willing to work with students, and are receptive to viewpoints developed by the students. It is essential to the success of the course that students know that their contribution to developing a deeper understanding of the issue has the potential to affect the outcome. In addition, establishing contact and interchange with managing agencies can help students develop a sense of professionalism and responsibility in their work.

Complex. The issue must be sufficiently complex that it can sustain the intellectual interest of 25 students for a semester. In addition, the issue must lend itself to being partitioned into four to six separate researchable areas for subdividing students into working groups.

Tractable. The problem must be tractable on some level in the time frame of a semester. In addition, the topic must lend itself to the development of a specific product. The product of the course is typically a scoping document detailing the interests of key stakeholders and potential approaches that incorporate those interests.

Course Structure

The course begins with an introduction to the purpose of the course, the active learning environment, and the topic. Instruction during the first two weeks focuses on four areas, with the combined purpose of introducing the students to the course approach and goals, and the specific topic chosen for the course. These four areas are: (i) background for the topic; (ii) conflict resolution, focusing on interest-based problem solving; (iii) working positively with a team; and (iv) planning and presentation. In addition to covering these four areas, much of the early work of the semester is demonstrating to the students that the learning environment will be entirely active from the first day of class. Students work outside of the classroom for much of the course, interacting with professionals and lay people who have stakes in the issue. Thus, the early part of the semester also stresses the need for students to behave professionally in their interactions, and we give them guidelines for what this means.
Having laid the groundwork for active learning and the expectation of professionalism, four to six speakers representing key stakeholders are invited to the class to present their views of the issue. Stakeholder presentations give the students a common background on the issue, and also give them immediate, substantive initial understanding of the issue, as well as a preliminary contact with several key players, including those responsible for managing the issue.

Students break into working groups by the third week of the semester. To date, students have been placed in groups based solely on their interests. Students are asked to give their first, second and third choices for group selection, and the instructors place students into groups of three to five based on these preferences. This method of formulating groups has usually, but not always, resulted in positively functioning group dynamics. Two times in six years we have had to disassemble a single group into two subgroups to circumvent counterproductive group dynamics. We do not have a problem with group sizes changing due to students dropping the course since it is a required course taught in the last semester of the senior year.

Positive or negative group dynamics can be a critical pivot point to the course, and we are considering using different methods for breaking students into groups in the future. For example, we could formulate groups based on considerations such as proximity to campus, individual strengths and weaknesses, and prior experience working together. Then a democratic process could be used for determining which groups work on which aspect of the issue.

The purpose of breaking into groups is to divide the work among the class members in a definable manner. There is inevitably considerable overlap among groups, and secondary groups are often formed consisting of members representing each of the primary groups. This helps to prevent duplication of effort, and also serves as a source of idea generation across groups. Group assignments will be described more fully under the case studies below.

Timelines are superimposed on the students in the form of periodic progress reports assigned to groups (not individuals). The course emphasizes written and oral skills throughout the semester, with students presenting a series of group progress reports, both oral and written, to the rest of the class. The first report is a semester contract that states what the groups’ goals are and includes an outline of their approach to achieving their goals. Designing the contract is usually an iterative process requiring periodic interactions with the instructor to develop sufficient focus for the project goals and approaches. For each subsequent periodic report, students report orally to the whole class, which provides for feedback from classmates as well as the instructor. Written reports are posted by email to all students and a hard copy given to the instructor for comments and grading. Interchange of ideas among the groups is essential to the efficiency and productivity of the class project, and in addition to formal reporting there is ample class time for working on the project within and among groups.

Letter grades are required for this course because it is part of the core curriculum for the major. Although 70% of the grading in the course is based on group effort, there are several avenues for differentiating among individuals within groups. Students are required to keep a course log, much like a consulting log, which contains information on "billable activities.” Three times during the semester the logs are graded for how much activity is apparent (is the student actively collecting data?), and for thoughtful commentary (is the student actively thinking about the topic and how to gather needed information?). At midterm and semester’s end, students are required to write detailed peer evaluations of their group members. After the midterm evaluation, a summary is furnished to each student, with the goal of spurring better group effort where it may be deficient. Students are graded both on how conscientiously they write their evaluations of peers and on how they are evaluated by their peers. This has proven to be an effective tool for alerting those students who may not realize that their contributions have been perceived to be lacking or somehow problematic, and allows time for students to improve their contributions before the end of the semester.

Role of Instructor

The course is set up as though the instructor is the supervisor in a consulting firm, and the students are employees, working in a team on a specific project. Throughout the course it is imperative that the instructor avoid expressing personal values and opinions, as the students are often very susceptible to those values expressed by the instructor. The role of the instructor is to provide guidance, stimulate creativity, and help to minimize negative aspects of team conflicts, while treating the students as competent professionals. This requires a tenuous balancing act of providing guidance while minimizing intervention.

Although this course is taught by one instructor, additional support for the course comes in two forms. An extension associate who is an expert in group process and conflict resolution serves as a “process consultant.” In this capacity she contributes by providing a “sounding board” for the instructor to discuss course progress, providing constructive approaches to resolving conflicts and frustrations within the class. She also leads the class sessions addressing process, including group dynamics, identification of personal values, and conflict resolution. A group of about four faculty serve as “faculty advisors.” The faculty who participate each year are chosen to represent a diversity of fields, and typically have some familiarity with the issue. These faculty members introduce themselves to the class within the first three weeks, and address, from their own perspectives, questions they see as key to developing a full understanding of the issue. These faculty members are then available to the students for input on aspects of their research that are related to their areas of expertise. The faculty advisors help to direct the process and stimulate the students to think beyond the data they have collected.

Product

The final product of the students’ efforts is a scoping document. This is both a written report and a presentation to managers and other stakeholders, coauthored by the entire class. This document provides detailed background to the issue, identifies stakeholders, and provides insights into their interests. The scoping document describes approaches to management of the resource that rely on an interest-based
Designing the final report is a difficult yet pivotal process that begins one-third of the way through the semester. The entire class, broken into smaller groups (but not their usual working groups), brainstorms approaches to the structure of the final report during an intensive 3-h working session. Students negotiate among the groups regarding the structure of the report, as well as the relative importance of specific aspects of the issue or results of their research. The result of this initial process is a rough outline needing considerable refining. Responsibility for the next phase of report design is taken on by a separate “final report group” of about five students representing each of the project working groups. This group, in consultation with the instructor, develops a detailed outline for the final report and presentation. This outline is taken back to the class for modification and approval. This is a lengthy and usually difficult process that ultimately results in a strong sense of student ownership of the final outcome of the class project.

SUCCESSFUL CASE STUDIES

Two topics used in teaching the course were particularly successful. Descriptions of them provide a picture of how the course functions.

Case Study 1: A Scoping Document for the Revision of a National Forest Land and Management Plan

In the winter of 1997, the Daniel Boone National Forest had just finished the process of gathering public input prior to mandatory revision of the Forest Land and Management Plan. The U.S. Forest Service (USFS) was in the process of compiling these comments when the class convened. Compilation of the public comments by the USFS provided both a definition of key issues and identification of stakeholders. Issues addressed from multiple viewpoints included off-highway vehicle (OHV) use and access, logging practices, endangered species, and rock bolting. Stakeholders represented a broad spectrum of views, and included advocates for OHV use, sportsmen, climbers, other outdoor enthusiasts, and environmental groups with a wide range of concerns.

For this topic, students were broken into six groups. The two key issues surrounding the forest plan revision that the students decided to address were OHV use and logging. We created two groups for each of these two issues (four groups total), to focus on biological resource issues and socioeconomic issues specific to OHV use or logging. Two additional groups focused on the USFS as a stakeholder, and the historical and legislative context for the current planning issues.

High Profile. Forest use and forest issues had been in the news regularly. Forest harvesting had been the subject of lawsuits filed by Heartwood, an environmental group that focuses on forest issues. Use and management of the National Forest were frequently addressed in newspaper editorials throughout the eastern region of the state, and public demonstrations at the USFS headquarters and district offices had occurred.

Multiple Stakeholders. Self identified from the public comments to the USFS and from newspaper articles and editorials, stakeholders included the managing agency (USFS), sportsmen, recreationists, local landowners, loggers, preservationists and conservationists, and OHV users.

Interest-Based Approach. Rich with multiple positions and interests, this issue was amenable to an interest-based approach. Federal mandates require the USFS to provide for multiple and often conflicting uses, yet constrain federal agencies from convening groups to develop interest-based solutions.

Undetermined Outcome. Development of the Plan was still in its formative stage, and the USFS Planning Team was actively engaged in the process of considering approaches to accommodating widely divergent public interests. Thus, there was a specific role for the class in identifying the interests that underlie the positions that were being communicated, in some cases vociferously.

Specific Focus. The USFS as the managing agency was the primary decision-maker. Students were in the unique position of attempting to increase understanding among all stakeholders. For example, students often found themselves in the position of explaining to non-USFS stakeholders the federal mandates and constraints imposed on the USFS, thereby demystifying the federal agency. Conversely, the students were in some cases able to identify common interests, as well as areas of conflict, that the USFS had not clearly identified.

Complex. This issue included legal, political, social, economic, and ecological aspects. Because of the high degree of complexity inherent in this issue, the students restricted their focus to issues of conflicting human perspectives and needs, and potential approaches to addressing them. This included developing a thorough understanding of federal laws and mandates governing USFS actions, and interpreting the legal constraints placed on the USFS to other stakeholders. The students also developed sociological understandings related to culturally defined forest uses, thereby providing a platform from which to contribute to USFS understanding of other stakeholders. Finally, the students restricted their research to issues related to forest harvest and recreation, two pressure points in the development of the Forest Plan.

Tractable. The formulation of a Forest Land and Management Plan is a multiyear process, and somewhat intractable even to USFS planning personnel. Nonetheless, by focusing on the development of a scoping document to help define stakeholders and their interests, rather than the entire planning process, the students were able to bring the class project to closure.

Constructive interactions between students and stakeholders occurred during the final presentation, but were not restricted to it. For example, discussions with USFS personnel during the semester spurred self-reflective and individualistic responses from USFS personnel obviously grappling personally with contentious management decisions. In addition, conversations with some groups revealed a sense of alienation from the USFS as well as a naivete to some of the constraints under which the USFS is required to operate. The students were effective in providing them with an alter-
nate perspective because of their objectivity relative to specific outcomes.

The entire Planning Team for the Forest Plan attended the final presentation, along with several other USFS employees involved in the process and including the forest supervisor. A very dynamic question and answer period followed the presentation, during which the students responded knowledgeably and professionally to challenging questions and statements. Agency personnel were genuinely interested in understanding the perspectives developed by the students in their interactions with other stakeholders.

**Case Study 2: A Scoping Document for Maximizing Success of the Kentucky Elk (Cervus elaphus) Introduction**

In the winter of 1998, the Kentucky Department of Fish and Wildlife Resources (KDFWR)—in cooperation with the Rocky Mountain Elk Foundation (RMEF), the Cyprus-Southern Realty Corporation, and the University of Kentucky—launched the largest elk introduction in the history of the eastern USA. Approximately 200 elk were released between December 1997 and February 1998 onto surface-mined land owned by Cyprus Corporation, with 200 additional elk planned for release in each of 1999 and 2000, for a total of 600 released animals. Aside from the Kentucky Farm Bureau Federation, which was concerned about row crop predation, the elk introduction had few public detractors in January of 1998, when the course was convened. Nonetheless, this topic appeared to meet the key criteria for a successful topic.

For this topic, students were divided into large groups, with smaller working groups, as follows. Four students were responsible for researching the historical and future potential ecological role of elk in the region of introduction. A group of six students examined the experiences and outcomes of elk introductions at other eastern USA locations. This group subdivided into two working groups of three students each and divided their work geographically. Eight students focused on the four cooperating partners as stakeholders, dividing into working groups of two students assigned to each of the four cooperators. Finally, a group of eight students was charged with the task of identifying other stakeholders in the elk introduction, and developing an understanding of their interests relative to the introduction. This group split into two working groups of four students each for assigning and completing specific tasks.

**High Profile.** The release of the elk was highly publicized throughout the state and the initial release was a public event attended by the governor and a crowd of interested onlookers.

**Multiple Stakeholders.** Despite minimal public dissent to the introduction, there were many stakeholders in the issue. Stakeholders included the four cooperating partners, citizens in the 14-county area identified as ideal habitat and defining the release area, and members of the public within Kentucky and the surrounding states. Strong support for the project was voiced by state and regional wildlife and hunting groups, whereas local response was more ambivalent, and even suspicious.

**Interest-Based Approach.** The issue was responsive to an interest-based approach because the cooperating partners were interested in garnering as much public support as possible for the project, particularly within the release area. Despite the lack of initial dissent among citizens, a successful introduction will require a very long commitment by all affected parties. Support of the elk population by local citizens could be pivotal to the long-term success of the introduction, and this is very well understood by the KDFWR.

**Undetermined Outcome.** The outcome of the elk introduction was not predetermined, despite the commitment of four cooperators and sufficient funds to introduce 600 animals during 3 yr. Problems encountered during the first year, from either the biological or sociological perspectives, could potentially thwart future releases. In addition, how well the introduction proceeded could be linked to acceptance of the idea by area residents. Agency responsiveness to the concerns of the public was expected by the class to be of key importance to long-term success.

**Specific Focus.** This issue had both a primary managing agency, KDFWR, and a powerful nonprofit organization, RMEF, contributing most of the funding for the 3-yr introduction phase of the project. Both groups were willing to cooperate with the class, and the KDFWR was receptive to contributions the class could make to the continuing management of both the releases and the resulting population.

**Complex.** This issue provided sufficient complexity, especially in the realms of potential sociological and biological impacts, for a semester-long project. From the sociological perspective, the introduction of elk to the region has the potential to increase tourism revenues, thereby stimulating a historically depressed economy. Despite a lack of publicly voiced dissent to the introduction, people in the local communities had strong and varying reactions to the arrival of the first elk, the degree to which they were included in decision-making, and their relationship to the agency. Biological issues included the impact of the elk on habitat, the ability of the habitat to support the elk population, and the biological success of the elk themselves, including surviving the move and becoming reproductively successful.

**Tractable.** This issue was tractable as long as the focus remained on short-term sociological and biological impacts, on the projection of potential impacts into the future, and on suggestions for cultivating a shared sense of success by all stakeholders. The theme for the semester was,“How do you define a successful elk introduction?” This theme acknowledged the fact that introduction of elk was inevitable because of decisions already made at the state level. Our approach focused on ways to maximize the benefits of an introduction program that was agreed upon by a small group of individuals, but will affect many people for a long time.

The final presentation addressed the need for increased communication between the agency and local communities, including soliciting greater input from them to secure a broader base of support for the elk introduction program. Most of the community-level concern heard by the students in extensive interviews of local people addressed feelings of disenfranchisement from the process and the potential for that alienation to be played out in poaching of introduced animals. The students also addressed biological concerns.
brought to their attention through multiple interviews with biologists involved with the project and on-site visits to the surface mine where the elk were initially introduced.

Six agency personnel attended the final presentation and participated actively in the question and answer period that followed. Agency personnel were responsive to suggestions made by the students, and communicated after the presentation that they had heard some new information and new ideas about ways of managing concerns that previously had not been apparent to them. The final written report was sent to top agency officials as well as local managers per request, reflecting interest across management levels.

### POTENTIAL PITFALLS AND SUCCESSFUL CORRECTIONS

Despite the successes we have had in developing and teaching this course, the outcome remains distressingly dependent on the group dynamics of the class, the relationships that develop between instructor and students, and the presence of several students with strong leadership abilities and excitement about the topic. In 6 yr of teaching the course we have never failed to have these attributes; however, some years have been more successful than others. We think there are several factors that contribute to stronger course outcomes.

A key aspect of the productive functioning of the course is dependent on students becoming comfortable with the unusual role they play. Thus, an area needing further development is to promote independent thinking by the students during the semester without leaving them feeling lost for direction. Increased awareness of this potential problem can be used to promote discussions that help to identify student frustrations at key points during the semester.

A related problem is that the students need guidance, but if guidance shifts to intervention, a key purpose of the course, that of creating a learning environment in which students develop the skills of professionals, is lost. To benefit from an active, problem-solving course the students must have the freedom to exercise their own choices and risk failure. In the history of this course there have been mistakes made by students from which they learned tremendously. For example, a couple of students interviewing stakeholders in one of the elk release communities communicated their own bias that the introduction was not a sound ecological decision. Word of this filtered back to personnel in the KDFWR, and further conversations with KDFWR wildlife biologists became very strained. The students learned first hand that a key to contributing to dialogue among stakeholders may be the withholding of personal viewpoints.

The dependence on group work inherent in the course is both a potential strong point and a source of much frustration that may detract from the course outcome for some students. The role that group work plays depends largely on within-group and within-class dynamics. There are multiple ways that the instructor can approach group work to support students in their efforts to develop positive group working dynamics, and the development of this instructional component of the course is an important role of the instructor.

Related to this is the fact that this capstone course is required of all students in the curriculum. Thus, most of the students have known each other in some capacity before taking this course, and sometimes that capacity has been in a group working context, positive or negative. Historical interactions among students can play an important role in current interactions, a role often invisible to the instructor, who did not observe the previous interactions. An approach to addressing this potential problem is again to address group dynamics explicitly as part of the course content, rather than leaving it to students to work out their inter- and intra-group conflicts.

### COURSE EVALUATION

Each year the students evaluate the course using the standard anonymous evaluation instrument used by the University of Kentucky. The results of student evaluations for five learning outcomes relevant to the course objectives, as well as the overall quality of the course and the teaching, showed that the course was highly rated by students (Table 1). However, ratings did vary among years. The highest scores were given in 1997 and 1998. In 1999, the students gave the course the weakest scores since the inception of the course. In 1998 and 1999 we asked additional course-specific questions on the same anonymous evaluation form (Table 2), and again, scores were much higher in 1998 than in 1999.

Strong scores in 1997 and 1998 likely reflect both very good course topics and strongly positive group dynamics. The topics in 1997 and 1998 offered excellent opportunities for contact with the managing stakeholders as well as other stakeholders involved in the issues. The rural–urban land management topic used in 1999, while a very current topic
possessing readily identifiable stakeholders, proved to be too complex and dynamic. The students continually felt that their discoveries were a step behind information being printed in the local newspaper.

It is impossible to separate the quality of the topic from group dynamics in their effects on course learning outcomes. Nonetheless, we think that group dynamics play an important role in the course outcome. For example, the 1997 and 1998 classes both had strong positive leaders who nurtured a group spirit that seemed to create and sustain a positive learning environment. In contrast, the 1999 class had several strong leaders who were openly negative about the course approach and time commitment required by the course. Future course development will need to address strategies for decoupling individual student attitudes from group dynamics.

Student ratings in 1999 were low for both the standard and course-specific evaluation questions. Because of this, we think the 1998 scores on the course-specific evaluation may be more valuable for informing future course development decisions. The five questions relating to the usefulness of this course in the Natural Resources Conservation and Management Curriculum or to their future roles as natural resource professionals received the highest marks (4.6–4.7; Table 2). Questions directed at determining whether specific course objectives were met received mean scores between 4.1 and 4.4. These somewhat lower scores suggest the need for more explicit focus on interest-based problem solving, integration of prior knowledge, student independence, and the active learning environment. The students are doing each of these things, but they apparently are not as aware of it as we would like. A low mean score of 3.6 was given for the statement “the instructor provides enough guidance to keep the students on track, without being too directive.” It is impossible to know whether they felt there wasn’t enough guidance or there was too much directive, so we split this question into two separate questions for the 1999 evaluation (Table 2). In 1999, student ratings suggest that the students felt there was insufficient guidance, but did not feel the instructors were too directive. The low scores on these questions highlight the most difficult task for the instructor teaching this course.

**CONCLUSIONS**

Recognizing that disciplinary courses are necessary, but not a sufficient means for preparing natural resources students for the multidimensional problems they will face in their professional lives, we have designed an innovative course. This course requires synthesis of previous knowledge and simulates some of the uncertainties and frustrations of working on complex natural resource problems with team members. By providing a safe environment for exploration of a current natural resource issue, we are attempting to help students prepare to successfully negotiate (in every sense of the term) difficulties they will encounter in their professional careers. There is ample opportunity for leaders to emerge within the class, and for students to appreciate each other’s strengths and weaknesses and work with each appropriately.

This course is very much a process, rather than a neat unfolding of information passed from instructor to student. The students (and instructors) experience the course as being a tremendous amount of work, not only because there is so much to learn and do in a single semester, but also because the process itself can be exhausting. Typically, the students do not recognize their accomplishments until the final presentation, in the last week of class. At this point, there is a near universal sigh of relief at being done, but also elation when they realize how much they have accomplished. This important sense of accomplishment at the end requires the attendance of interested stakeholders at the final presentation, as it is their interested questioning at the end of the presentation that communicates clearly to the students that they have uncovered some new understandings.

**ACKNOWLEDGMENTS**

We acknowledge the students who participated in the course over the past 6 yr, contributing through their participation and their written comments to the ongoing development of this course. This is publication no. 99-09-122 of the Kentucky Agricultural Experiment Station.

**REFERENCES**


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**Table 2. Student ratings of the course in 1998 and 1999 using an assessment instrument designed for the course. Rating scale is based on a 5-point scale, from strongly agree (5) to strongly disagree (1).**

<table>
<thead>
<tr>
<th>Question</th>
<th>1998</th>
<th>1999</th>
</tr>
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<tbody>
<tr>
<td>The topic worked well for the course objectives</td>
<td>4.4</td>
<td>4.0</td>
</tr>
<tr>
<td>I understand the interest-based approach</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>The focus on interest-based problem solving was valuable</td>
<td>4.2</td>
<td>3.7</td>
</tr>
<tr>
<td>This course required integration of disciplinary knowledge</td>
<td>4.1</td>
<td>3.1</td>
</tr>
<tr>
<td>This course required me to build new skills</td>
<td>4.7</td>
<td>3.7</td>
</tr>
<tr>
<td>This class was an effective bridge to being a professional</td>
<td>4.6</td>
<td>3.2</td>
</tr>
<tr>
<td>Course structure promoted independence, active learning, and problem-solving</td>
<td>4.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Instructors provided enough guidance without being too directive (1999 only)</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Instructors were too directive (1999 only)</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>My group had to change direction at least once</td>
<td>4.6</td>
<td>4.4</td>
</tr>
<tr>
<td>This type of flexibility will be an important professional tool</td>
<td>4.7</td>
<td>3.9</td>
</tr>
<tr>
<td>This course is an effective part of the curriculum</td>
<td>4.6</td>
<td>3.6</td>
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