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STUDENT TEAM PROJECTS AND NATURAL RESOURCES EDUCATION: ARE WE ACHIEVING EDUCATIONAL OBJECTIVES?

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ABSTRACT: As college instructors have recognized the benefits provided by cooperative and active learning, many have shifted from their traditional teaching style, dominated by lectures, to a new style where students work together and learn from each other as well as from the instructor. One strategy commonly used to implement cooperative learning in the classroom is to require students to work in teams to complete a class project. This strategy is particularly attractive to natural resources educators because natural resource issues are generally complex and interdisciplinary providing a natural setting for teaching concepts regarding natural resources ecology and management using student team projects. Further, natural resources agencies are seeking to employ individuals who have the skills to work in interdisciplinary teams to address current problems. Thus, assigning projects to student teams in natural resources classes can serve several important purposes: it can aid student mastery of the subject matter by creating a cooperative learning environment; it can provide a hands-on, problem solving context for student learning; and it can provide students with the necessary skills and experience to work effectively in teams as professionals. Although using student team projects has many potential benefits, the effectiveness of this approach as a teaching tool can vary greatly. We reflect on our experiences with using the team approach in three different courses: Fishery Management, designed for junior and senior level students; Natural Resources Decisions, a capstone course designed for seniors in the School of Forest Resources; and Watershed Management Planning, a graduate level course. As a result of our collective experiences in these three courses, we propose that investing a relatively small amount of class time to introduce students to the concept of a team and how teams work can increase the effectiveness of teaching by using student team projects.

INTRODUCTION

The process of natural resource management is becoming increasingly multidisciplinary as natural resource agencies move towards "ecosystem management" in an attempt to manage natural resources in relation to their physical, chemical, biological, and social environments (Barinaga 1996, ESA 1995, USGAO 1994). For example, the U.S. Environmental Protection Agency (EPA) is promoting a watershed approach to address water quality problems. EPA describes the watershed approach as a coordinating framework that integrates a wide range of environmental objectives with objectives for economic stability and other social and cultural goals (USEPA 1996). Another example of the multidisciplinary nature of current natural resource management issues is found in fisheries management. Fisheries managers working at federal and state natural resource agencies are commonly asked to predict the economic and cultural effects of changing fishing regulations as well as to predict the effect of these changes on the fish population (Krueger and Decker 1993). In forest resources management, the relatively new concepts of timber product green certification requires foresters to evaluate sociological as well as biological impacts of harvest decisions (Shissler 1997).

Because it is unlikely that every individual can be sufficiently trained in all required areas, a team approach is being advocated for decision making regarding the management of natural resources (Krueger and Decker 1993, Harville 1985). As a result, natural resource management agencies are seeking individuals who not only have an educational background in natural resource management, but who can also work effectively as members of interdisciplinary teams. A survey of fishery managers working for the US Forest Service revealed that "getting along with people" and "being a good team member" were the two top attitudes identified as necessary for success within the agency (Kennedy 1986). A recent report of the Interagency Ecosystem Management Task Force (IEMTF), created by the federal government to implement a recommendation of Vice-President Gore's National Performance Review, noted that the U. S. Forest Service and other federal agencies are focusing on training top leadership in techniques for collaborative, interagency planning to carry out the ecosystem management approach

(IEMTF 1995). State agencies are also relying on a team approach to address current natural resources management issues. For example, a Wisconsin Department of Natural Resources report to its managers asserted, "Managers working in integrated teams will form the foundation for the way we 'do' ecosystem management" (WDNR 1995).

Natural resources educators have been challenged to achieve several goals in undergraduate education including teaching students content (i.e., natural resources ecology), process (i.e., the process of establishing management plans and options), and effective teamwork. Many have acknowledged the benefits of cooperative and active learning and have tried to shift their teaching style from one dominated by traditional lectures that emphasize content to one that motivates students to learn cooperatively and experientially in order to emphasize content, process, and teamwork. Cooperative learning is defined as the use of small groups in instructional settings where students work together to maximize their own learning as well as each other's learning (Johnson et al. 1991a, b). Extensive research has shown that students who work in effective cooperative learning groups tend to learn more, better understand what they are learning, have better retention of learned material, and feel better about themselves, their classmates, and their peers than students who are engaged in individualistic or competitive learning situations (Johnson et al. 1991a, b). Experiential learning can be defined as providing the students with the opportunity to experience their learning as opposed to simply telling them what they are to learn (Eitington 1996). Whereas traditional lectures emphasize content, experiential learning emphasizes both content and process. Studies comparing the learning retention of students engaged in experiential learning situations versus students exposed to the same material in a lecture setting found that students who learn experientially retain 70 - 90% of the material presented while students who learn through lectures only retain 10 - 20% of the material (Eitington 1996). Thus, using cooperative and experiential learning strategies to teach natural resources management is attractive not only because student learning and retention is enhanced, but also because skills for working effectively in teams are learned.

One way to implement cooperative and experiential learning strategies in the natural resources education classroom is to assign "real world" projects, such as developing a management plan, to student teams. The approach of using student teams to work through the process of developing management plans for natural resources can serve several important purposes: it can aid student mastery of the subject matter by creating a cooperative learning environment; it can provide a hands-on, problem solving context for student learning; and it can provide students with the necessary skills and experience to work effectively in teams as professionals. Although using student team projects has many potential benefits, the effectiveness of this approach as a teaching tool can vary greatly. According to Johnson et al. (1991a, b), in order for student groups to be truly cooperative, the following five basic elements must exist. First, positive interdependence is present when students believe that they are linked with their team members in a way that no individual can succeed unless all of the group members succeed. Second, face-to-face promotive interaction is present when students not only teach each other, but also encourage each other's learning efforts. Third, individual accountability/personal responsibility requires that the instructor assess the performance of each individual student and provide feedback to the individual and the group. Fourth, collaborative skills including leadership, decision-making, and communication are necessary for team functioning and have to be taught. Finally, group processing requires the group to assess how well they are achieving their goals and how to maintain effective working relationships between group members.

We reflect on our experiences with using the team approach in three different courses offered at the School of Forest Resources, Pennsylvania State University: Fishery Management, designed for junior and senior level students; Natural Resources Decisions, a capstone course designed for seniors in the School of Forest Resources; and Watershed Management Planning, a graduate level course. As a result of our collective experiences in these three courses, we propose that investing a relatively small amount of class time to introducing students to the concept of a team and how teams work and to structuring and evaluating teams can increase the effectiveness of teaching by using student team projects.

EXPERIENCES WITH TEAMS IN NATURAL RESOURCES COURSES

Fishery Management (WFS 463)

Fishery Management is a course designed to introduce students to the process of fisheries management and to survey major methods of management involving people, fish populations, and habitat. It is taught as a part of the Wildlife and Fisheries Science curriculum at Penn State University, but students from other majors, including Biology, Geoscience, and Environmental Resources Management, also enroll in the course. Approximately 25 juniors and seniors take the course each spring. The format of the course includes two 50-minute lectures a week and one three-hour laboratory/recitation session.

One of the primary educational objectives of the course is to provide the students with experience in developing and communicating a fisheries management plan. In essence, students should leave the course with knowledge of both the content of a fisheries management plan and the process required to develop such a plan. As the process of fisheries management is becoming increasingly multidisciplinary and a team approach is being advocated for decision making regarding the management of fisheries (Taylor et al. 1995, Krueger and Decker 1993, Harville 1985), the course uses a

team approach to simulate the work environment that most of our students will encounter once they graduate. Thus, to achieve the objective of providing students with experience in developing and communicating a fishery management plan, students are assigned to work in teams to develop a written management plan for a particular Pennsylvania fishery as well as a presentation regarding their plan.

During the lecture portion of the course, students are introduced to the process and techniques used to manage fisheries. In the beginning of the semester, several lectures are dedicated to outlining the steps necessary to successfully implement a fishery management plan. In the laboratory, students gain familiarity with the process through several small group exercises that allow them to practice going through the steps of developing a management plan. Lectures and laboratory exercises during the rest of the semester focus on different fishery management techniques that can be used to achieve the goals of a fishery management plan. About one-third of the way into the semester, the students are assigned to develop the fishery management plan for a particular Pennsylvania fishery following the steps outlined in class. To complete this assignment, students are randomly assigned to teams of four to five students. They are expected to work together to produce a written management plan (with all of the required background literature review) and to produce an oral presentation based on their plan. Most of the work of preparing the assignment is expected to take place outside of the classroom, although at least two laboratory sessions are dedicated for work on team projects.

Grading for the group project is based on the team's written report and oral presentation. Each individual is expected to contribute to the team's report and presentation, but only one grade is assigned to the entire team. Individual grades for the team project do vary as 10 percent of the total score is based on peer evaluation of each member's performance on the project. Each individual turns in a "grade" for each team member, including themselves. The team project constitutes a substantial percentage (approximately 33 percent) of each student's final grade in the course. The rest of each individual's grade is determined by individual performance on exams and short assignments.

The team approach to teach students the process of developing and content needed in a fisheries management plan has worked with varying success. In a few cases, students have truly formed collaborative, inter-dependent teams that functioned very well and produced fishery management plans that were well developed and thoughtful. In the cases where teams worked effectively together, their bond spilled over into other aspects of the class. In many cases, successful teams not only worked on their specific assignment together, but also studied for exams and discussed other assignments together. This interaction generally led to improved performance of all team members in all aspects of the class (demonstrated by improved scores on exams and assignments in the latter portion of the course as compared to the beginning). Further, peer evaluations were very positive, focusing on people's strengths and what new insight they were able to contribute to the project. In these few cases, the essence of cooperative learning as described by Johnson et al. (1991 a, b) was achieved, and the students learned both process and content.

In some cases, student teams have failed to deliver an acceptable management plan in either written or oral format. In general, these were teams where strong personality conflicts caused students to not work together effectively and none of Johnson et al.'s (1991 a, b) criteria for cooperative groups was achieved. These "teams" usually put something together in a rush just to get the assignment completed; many times the product is the result of the efforts of one or two people in the group. Needless to say, the peer evaluations from groups at this extreme are generally very negative focussing on the faults of all team members. Students in this category also express resentment at being forced into working in a group and feel that they could have done much better in the course if they would have worked individually.

In this class, however, most teams have fallen somewhere in between the two extremes. Most teams get together, assign different parts of the project to different individuals, but do not work together again until the end when all of the different parts need to be integrated. In this case, the individuals function as a group, but few if any of the characteristics of a cooperative group (Johnson et al. 1991a, b) are achieved. The written report and oral presentation are often disjointed as they consist of several individual parts loosely put together.

In general, most students leave fisheries management with knowledge of the content that is necessary to build a management plan. However, except in the few cases where teams do work cooperatively, most students gain little insight into the process involved in formulating a management plan. Failure of these teams to work cooperatively relates to several things: 1) the way teams are structured (randomly), 2) lack of instruction regarding the role of teams in natural resource management and as to how teams should function, 3) lack of milestones or progress checks during the project (i.e., the students do not hand in any interim products), and 4) student concerns regarding grading. Suggestions for addressing these problems are made in the "Suggestions for the Future" section.

Natural Resource Decisions (FOR 497E)

Originally designed as the capstone for a new program in the School of Forest Resources that never developed, Natural Resources Decisions (NRD) continues into its fifth year as a general elective for seniors in the School and across the university. The largest enrollment to date is 25 students. Through the use of two major projects, NRD allows students to use previous coursework and life experiences to develop appropriate resources and solutions. More importantly, the

projects demand that students collaborate as they develop their solutions.

The projects chosen for the course represent two extremes. The first, the development of a forest resource management plan for a large private ownership, represents a relatively well-defined project with specific owner described objectives. The second, most often a large multi-faceted public policy question, is a project with diverse clientele, controversial issues, inadequate information, and requiring a solution that is best crafted through a group process.

In the past, instructors have deliberately minimized their involvement allowing students to discover their individual strengths and the need to work collaboratively. To accomplish this, the instructors seldom present formal lectures. Rather, they lead students through discussion to identify project elements, such as the parts of a management plan, identifying landowner objectives, developing questions for conducting a landowner interview. As students identify tasks in preparation for developing the plan, they naturally begin to work in teams that use their individual strengths.

The landowner parcels examined in the first class project, the development of a forest management plan, have been as small as two hundred acres and as large as a thousand. We invite the landowner to present their objectives to the class. Through question-and-answer with the landowner, the students discover information about the property and the extent of the project. The syllabus clearly shows two three-hour visits to the property for collecting necessary data. Although we encourage students to work together, they most often fail to realize that this is a class project. Only when faced with data collection, under apparently impossible conditions, do they raise the prospect of doing a class plan.

This project culminates with a class presentation of their plan to the landowners. During a dress rehearsal, students work to meld their comments into a coherent report. Most often we find significant development at this stage as the students realize that they have to work together to ensure that each individual is prepared and can do well in order to make the entire group look good in front of the landowner; a professional spirit develops. Through this experience, the students begin to build the necessary characteristic of positive interdependence described by Johnson et al. (1991a, b). The presentation also seems to cement the students' commitment to the written document. They now have pride in what they are doing and are going to share.

The second project is more difficult. The issue is large, and the students need to rapidly develop an in-depth understanding of various perspectives, define information needs, and craft various strategies for addressing the problem. As a result of their experience during the first project, the students have some appreciation of the need to effectively work together to develop their response. The scope of the issue changes each year. In the past, the class has addressed issues such as the implementation of the state forest strategic plan on the district level, developing cooperative strategies for the Bureau of Forestry and the Game Commission to implement ecosystem management across ownership boundaries, and crafting an education program on white-tailed deer that would persuade hunters to permit herd reduction. As was the case in the first project, students develop their own niches in helping bring the project to fruition.

To lend reality to the project, we have had the state forester and his staff, a Game Commission section chief, outdoor writers and game commissioners present perspectives and ideas to the class. Having these professionals participate in the class early in the project emphasizes the importance of the issue and motivates the class to develop viable and creative responses. These same resource people return to the class at the end of the semester to hear and receive the class' final report.

A single class plan raises issues related to grading, sharing the load, and completing the project that begin to dominate class discussion. The class does develop a strong commitment to developing a useful project report that they can present to the landowner. The pressure to perform varies from student to student, some choosing an easier path than others. Often, conflict, either subtle or overt develops, providing an opportunity for the instructors to introduce conflict resolution skills and processes for team collaboration. In the second project, the students clearly understand what is expected of them. They pull together more readily, perhaps, even taking laggards to task achieving more positive interdependence.

There are opportunities for students to share knowledge with the class enhancing Johnson et al.'s (1991a, b) face to face promotive interaction. Enrollment from Wildlife and Fisheries Science majors normally dominate the class. Originally, the instructors anticipated a more equal split across majors, allowing students to share information and experiences that other team members may not have. This has not happened as frequently as hoped. From time to time, one or two students, frequently those from outside the School's programs can and do offer information useful to the class. These interactions may vary from impromptu presentations and to more formal interchanges.

The instructors encourage students to participate in class discussions, sharing ideas and information. About half way through the course, the instructors conduct an evaluation of each student's progress. One focus of this assessment is the student's participation in class. Students who dominate discussion as well as those who are too reticent are encouraged to examine their participation. Another part of this evaluation is a reflection, from the instructor's perspective, on how we perceive the individual is participating in the project. We encourage the students to discuss our perceptions and comments with us at a time convenient to them.

On the occasion of this teacher to student evaluation, we ask for a reciprocal evaluation. Our plan is unannounced and the class is asked at the beginning of the period to develop an oral presentation to the instructors by the end of the class period. This evaluation encourages students to develop their arguments and presentation skills. We have found this useful in both improving the course and in cementing class relationships. After this evaluation the students are more open, willing to express themselves to us and each other.

While students struggle with a seeming lack of guidance early in the course, they ultimately develop an appreciation for the approach as they understand that the course design permits them to experience "real life" projects and situations. Students frequently comment on the value of the course. Several returning students have said that lessons learned in NRD have helped them become more effective members of professional team projects. Instructor and student evaluations for the course are in general high. These scores coupled with student comments suggest that the course is useful and appreciated.

Special Project in Watershed Management Planning (FOR/ LARCH 597A)

Watershed Management Planning was an experimental course taught by four Penn State faculty in the Fall semester of 1996. The inspiration for the course was the anticipated visit of an international team of professionals in watershed management to the Spring Creek watershed, as part of an International Countryside Stewardship Exchange (Exchange). The Exchange was a week-long event organized by a local non-profit community organization and designed to have the international team of professionals learn about the watershed, the issues facing it, and to provide the community with recommendations. Because the Exchange was scheduled for the third week in September, it created an ideal opportunity to build a course focussed on watershed management planning.

The four faculty who designed and taught the course were themselves an interdisciplinary group -- a watershed planner, a fisheries biologist, and a forest hydrologist from the School of Forest Resources, and a landscape architect from the Department of Landscape Architecture. We recruited eighteen graduate students from a variety of disciplines, including Wildlife and Fisheries Science, Forest Resources, Soils, Agricultural and Biological Engineering, Environmental Pollution Control, Biology, and Ecology.

The goal for the course was to have graduate students learn about the complex process of watershed management planning and gain practical experience by developing a plan for the Spring Creek watershed (Ferreri et al. 1997). The specific educational objective was to produce students who could enumerate the key elements of a watershed management plan, identify and use appropriate data for assessing watersheds, translate issues identified into a management strategy, and work effectively in team situations.

The class met formally twice a week, once for about one hour and once for two to three hours. These class periods were used for lectures on technical topics related to watershed management and for group discussions. The students were expected to work independently and in groups outside of class. The role of the instructors was to provide guidance, information, and constructive feedback to the students as they developed their watershed management plans. The students spent the first few weeks of the semester learning about watershed management planning and the characteristics of the Spring Creek watershed in preparation for the Exchange. They participated in many activities during the Exchange. After the initial five weeks of the course, at the end of the Exchange week, the students were organized into teams of six to eight members each. The students were directed to work in interdisciplinary teams to develop the Exchange team recommendations into a watershed management plan for the Spring Creek watershed.

The course instructors asked the students to identify their skills and areas of expertise and interest and then assigned each student to one of three teams. From the information provided by the students, the instructors attempted to create heterogeneous teams with a range of expertise and skills, expecting that students would choose to divide up the teams' work by discipline or interest. In an effort to increase the diversity of each team, the instructors also divided up the five women in the class, with two teams each assigned two women, and one team assigned one woman.

This course was successful in achieving most of its educational objectives. It provided students with a framework for watershed management planning and a practical and personalized experience applying this knowledge. The final oral presentations and written reports of the students demonstrated that the teams were able to integrate the physical, biological, social, and economic components of the watershed into a management plan.

Grades were based on both individual and team performance, with team grades constituting the largest portion of a student's final course grade. The team score for the final oral presentation made up 25 percent of the grade; the team score for the written final report made up another 40 percent. In addition to instructor evaluations, each student was given the opportunity to evaluate the performance of the other members of his/her team in terms of their contribution to the team's final product. The peer evaluation made up 20 percent of a student's grade on the group project.

Achieving the proper balance between group and individual grades proved to be a difficult issue, and the students were very concerned about their individual grades. Although the instructors established their grading protocol at the beginning

of the course, most of the grading was based on the final products, and in practice it proved difficult to determine individual contributions to the team products. In the peer evaluations, many team members were unwilling to distinguish among their teammates, except for two students who were clearly considered by their teammates to have underperformed. Student evaluations of the course indicated that the evaluation process was a primary source of concern in this course.

Either because of, or in addition to the concern about grading, several students expressed discontent with the process of working on teams. It is not clear whether the watershed management planning course achieved its objective of working effectively in teams, at least for a few members of the class. The students were able to function in groups well enough to complete their group products. However, it is not clear how many of the elements for successful cooperative learning (Johnson et al. 1991a, b) were present except individual accountability for contributions toward the final team products. It is also not clear whether students developed the skills necessary to work effectively in groups in the future. In fact, for some students the class experience may have negatively affected their attitudes toward team work.

In addition to the grading issue, the instructors for this course concluded that our assumption that we could create successful teams simply by achieving a heterogeneous mix of skills, expertise, and interests was flawed. The separation of the minority of women into even smaller minorities within the groups was a problem for some of the women. Personality and work style conflicts also created serious friction in at least one team.

SUGGESTIONS FOR THE FUTURE

Using cooperative learning techniques in the natural resources management classroom has the potential to not only enhance student learning, but also has the added advantage of simulating real work conditions encountered by graduates in natural resource management agencies. Our success using team projects in classes to teach content and process has varied. In some cases, we have fallen into the trap described by Johnson et al. (1991b) who points out that simply placing students into groups does not necessarily lead to a cooperative learning environment. In many cases, we have failed to see Johnson et al.'s (1991a, b) five attributes of cooperative groups within our teams. We suggest that paying more close attention to the way teams are structured, providing instruction regarding the role of teams in natural resource management and how teams should function, actively checking progress of teams throughout the project, and addressing student concerns about grading should help us create truly cooperative learning teams in the future.

Structuring Groups With Potential to Succeed

Our experience with our three natural resource classes at Penn State University has led us to conclude that one of the issues we needed to pay more attention to in future courses is how to structure teams that have the potential to be successful. Research has shown that grouping people with complementary learning styles can enhance group performance (Miller et al. 1994). Miller et al. (1994) suggest that assessing student's potential learning styles and personality can be accomplished with a tool such as the Myers-Briggs Type Inventory. A Myers-Briggs Type Inventory would provide the instructor with the information necessary to structure groups that were comprised of individuals with complementary learning styles. However, this approach to structuring teams may be overly complicated for the novice instructor and may consume more class time than instructors are willing to spend.

In our experience, some of our less successful groups seemed to spend most of their time struggling with group logistics where even finding an appropriate time to meet was difficult for them. Yamane (1996) suggests that getting some minimal information from students at the beginning of the course can help structure groups in a way that addresses the logistics problems. In his introductory sociology course, Yamane (1996) begins by having students provide him with their work schedule, class schedule, and areas of sociological interest. He uses this information to form project teams that reflect the students' schedules and interests. We propose going one step further in gathering information from the students. Because we often deal with interdisciplinary teams in the natural resources management classroom, we suggest getting information regarding a student's background knowledge and experience in addition to their schedule and interest information. A simple one page questionnaire could be devised where the students provide their schedules, interests, and then rank their experience with several different skills that are related to the project being assigned. For example, for a watershed management project, students might be asked to rank the knowledge and experience with areas such as water chemistry analysis, macroinvertebrate collection, macroinvertebrate identification, fish identification, GIS, spreadsheets, word processing, and presentation graphics. A simple scale could be used to allow students to rate their knowledge within a subject area; for example, 0 could mean "no experience", ½ could mean "limited experience" or "have observed it once", and 1 could mean "very experienced" or "very comfortable with topic." The instructor could use such information to form groups that not only had compatible schedules, but also had complementary skills. This type of team structuring would promote positive interdependence as each group member would be an "expert" in some area and would be expected to use that expertise to help the team achieve their goal. In classes with students from a wide variety of disciplines and with various kinds of expertise, it might be helpful to create opportunities for students to educate each

other through the preparation of mini-lectures, white papers, or other exercises.

Provide Instruction About Teams

One of the common problems we faced in our three classes was getting students to feel comfortable working in teams. In many cases, students complained that they could be much more effective and efficient at completing the project if they could just work by themselves. In addition, many students expressed a feeling that working in groups to solve problems was simply an academic exercise and that they would never be asked to work in a group setting once they entered the work force. We attribute these types of comments to two things: 1) we often lack student "buy-in" into the idea that using teams to solve problems in natural resources is not only a good way to approach natural resource management, but is also the current approach used by natural resources agencies, and 2) students generally lack the collaborative skills necessary to make their team function effectively.

A simple discussion exercise during one class period may help to increase the students' confidence in the necessity for and the effectiveness of a team approach to natural resources management. Prior to the class period, students could be assigned readings on some pertinent natural resource issue (e.g., Pacific salmon issues in the Northwest for Fishery Management; the Chesapeake Bay nutrient reduction strategy for Watershed Management Planning; and Pennsylvania State Bureau of Forestry ecosystem management principles for Natural Resource Decisions). During the class period, students could be asked to discuss the disciplines needed to address the problem and how best to approach designing a management plan. By the end of the discussion, students should have a pretty good idea that a team made up of members with different backgrounds would be the best way to approach these complex natural resource problems. A short presentation regarding the use of teams in management agencies and additional readings (such as Kennedy (1986)) would increase the students' confidence in the team approach as a viable and timely way of approaching natural resources decisions. Role plays or games where teams are asked to solve problems unrelated to their academic disciplines may help demonstrate the value of teamwork. Several commercially available team survival simulations are used primarily in business organizational training, but may be successfully transferred to the classroom (e.g. *Desert Survival* by Human Synergistics Inc.). These team survival games consistently show that group performance is higher than the individual performance of any single member under the same survival scenario. They may help convince students that a team approach produces higher-order solutions to problems than an individual approach.

Johnson et al. (1991b) point out that most undergraduate students are products of competitive academic settings where individuals are rewarded for exceptional performance. As such, many students lack the collaborative skills needed to make a team work effectively. Collaborative skills, such as leadership, decision-making, communication, and conflict-management, need to be taught just as purposely as other academic skills (Johnson et al. 1991a, b). The instructor should introduce some basic ground rules for working in teams that the class could discuss. Some of these ground rules might include: schedule weekly meetings, value the diversity of team members, keep positive team dynamics, decide by consensus, everyone participates, and keep records of meetings (Mears 1994). Yamane (1996) suggests that to facilitate group dynamics, groups should assign each member a specific role. In his four person groups, four roles are defined and assigned: discussion leader, keeps the group on task by developing a meeting agenda; meeting recorder, keeps notes from each meeting with particular attention to work assignments and distributes these notes to all team members; meeting coordinator, identifies possible meeting times and locations based on member's schedules; and intermediary, meets with the instructor on a regular basis to report on the team's progress. For long-term projects, these roles could be rotated around the group so that each member has the opportunity to experience more than one group role. We believe that investing a lecture or two of valuable class time to help students discover the collaborative skills and ground rules needed for teams to work effectively will facilitate the building of truly cooperative teams by helping students identify (if not gain) the skills needed to achieve face-to-face promotive interaction and collaborative skills.

Actively Track Team Progress

Another trend we found in reviewing how we are currently using team projects in our classes is that we have rarely monitored group processing. Group processing involves a group discussion of how well the group is achieving its goals and maintaining effective working relationships among team members (Johnson et al. 1991a,b). Most of the monitoring we have done in our classes has been very informal, usually in the form of a class discussion about how the projects are going in general, or in response to students who express their concern about the progress teams are making or the direction that teams are taking. Yamane (1996) suggests that instructors should actively track the progress of each group throughout the duration of the project by setting up meetings with each group at the time each project milestone is reached. This type of active discussion between instructor and student team would help to facilitate group processing. During these meetings, instructors could not only discuss progress toward the final product with the group, but could also discuss how well the team is working together. As such, we suggest that team projects be assigned in a manner that allows teams to make progress toward the final product by reaching certain milestones. Meetings between the instructor and the student team could be held in conjunction with each part of the assignment being submitted. This approach, in conjunction

with using Yamane's (1996) intermediary, should enhance group processing.

Grading and Evaluation

Because of the anxiety that many students have about grades, this is perhaps the most difficult issue that instructors have to contend with in team-based courses. Good students fear their grades being lowered because of poor performance of other members of the group, and they often feel that they work harder than others to pull the group along. On the other hand, the poorer students may feel little incentive to work hard if their group is doing well without their full involvement. One approach may be to assign every student an "A" grade at the beginning of the course and to take points away from individual students throughout the semester based on instructor and peer evaluations of group processing and individual performance. Another approach may be to use a detailed numerical rating system such as that used by Professor Christopher Uhl at Penn State. Uhl has used a complicated numerical peer evaluation system for group projects in his undergraduate biology class, which subdivides the project into categories which are weighted and multiplied by individual and group peer grades. Another alternative may be to encourage the use of performance contracts among the group members which are as specific as possible about the group's expectations of quality, quantity, and interdependence from each member. While this approach would approximate a professional work environment, some teams could spend most of their time trying to agree on expectations. Our experience in the three natural resources courses we have taught suggests that group grading should not be left until the final product is completed, but include intermediate points for evaluation of individual and group progress throughout the course. This should reduce the anxiety level for most students and provide intermediate feedback for the group to positively encourage better performance from its members.

SUMMARY AND CONCLUSIONS

Our collective experience with three natural resource management classes at Penn State University has convinced us that assigning team projects can help achieve several educational objectives. Research has shown that creating an environment of cooperative learning will enhance student retention of material learned in a class. As such, using a team project in a natural resources management class can help students learn management concepts and strategies more effectively than using a traditional lecture approach. Experiential learning, where students learn by doing, has been shown to enhance learning and retention of process related information. Because natural resources management is a continuously evolving process, it is important for students to learn the process of management. Thus, assigning student teams to develop natural resource management plans in a team setting facilitates their learning by providing a cooperative learning environment and an experiential learning situation. However, in order for cooperative learning to be effective, teams must be truly cooperative as defined by Johnson et al. (1991a, b). Cooperative teams exhibit five characteristics including positive interdependence, face-to-face promotive interaction, individual accountability/personal responsibility, collaborative skills, and group processing (Johnson et al. 1991a, b). Our experience has shown that it is not enough to simply place students in groups to make them cooperative teams. In contrast, to create truly cooperative teams, the instructor must pay close attention to the way teams are structured, provide some instruction as to why a team approach is important and how teams should work, actively check on the progress of the group throughout the project duration, and address student concerns about grading. We suggest that investing a small amount of our valuable class time to ensure that students believe in and understand the team approach will enhance our success with using team projects in the future.

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