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INCORPORATION OF PEER LEARNING IN AN AGRICULTURAL CURRICULUM

by

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Abstract

Peer learning is a teaching technique that requires students to take an active role and responsibility for teaching to, and learning from, their classmates instead of relying only on instructor-delivered information. It is a useful tool for developing critical thinking skills among students in a variety of agricultural disciplines. Two courses (Plant Propagation and Food and Agricultural Policy) at a University of Florida satellite undergraduate teaching program were independently modified to incorporate peer learning exercises. Implementing these exercises in the classroom enabled students to better understand and evaluate complex subject matter. Oral communication skills, enthusiasm for the subject matter, self-confidence and classroom interaction also improved as a result. Based on course evaluations and responses to specific enquiries about peer learning, students were supportive of the peer learning activities and felt they had gained from the experience compared with only traditional instructor-led lectures. In addition both instructors had favorable reactions to incorporating peer learning. Since the amount of content delivered normally decreases in an active learning atmosphere, an important additional benefit of the exercise was the ability to tailor course material and examples to the specific interests of the students.

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by
Sandra B. Wilson and Suzanne D. Thornsbury*

Introduction

Including critical thinking skills in the classroom environment is not a new concept for improving pedagogy (Black, 1952). Academic scholars and educators have long recognized the benefits of teaching students how to analyze and evaluate events as opposed to rote repetition of established “facts” or theorems. Such an approach becomes even more important in the modern teaching environment, where students and instructors can easily be overwhelmed by the rapid evolution of new ideas and the ever-expanding amount of information available. As the pace of change continues to accelerate, the ability to find and evaluate information, adapt, and think critically become increasingly valuable skills that employers demand from students entering the workforce.

Creating opportunities to develop critical thinking skills among students requires restructuring the traditional lecture format of classes. The focus of learning moves from one of content-orientation to one of process orientation (Meyers, 1986). To make a successful transition, the amount of content delivered by the instructor routinely decreases while an increased emphasis is placed on methods of information presentation and analysis that incorporate student participation in an active learning environment. Consequently, there is a shifting away from the lecture format and a move towards a

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more interactive classroom. More active participation by students in the classroom has been shown to increase complex learning and retention of material (Clement, 1971).

A number of different techniques can be utilized to increase active student participation. One such technique is peer learning where students take an active role and responsibility for teaching to, and learning from, their classmates instead of relying only on instructor-delivered information. Early experiments in educational and general psychology showed that exam performance and the interest level of students taught in small student-led discussion groups was similar or superior, respectively, to that of students taught in instructor-led discussion groups (Gruber and Weitman, 1962). Subsequently, the effectiveness of peer learning has been well documented for a wide range of subject contents, educational levels, and personalities (Johnson and Johnson, 1975; Webb and Grib, 1967). Yet peer learning is one technique that often remains underutilized in creating today's active learning atmosphere. Within the last decade, increased student enrollment and decreased financial support for teaching faculty appointments have resulted in a much higher student: teacher ratio in many institutions (McKeachie, 1994). As a result, it has become increasingly challenging for instructors to incorporate individual peer learning exercises into their courses, and this valuable critical thinking tool is often underutilized. The objective of this paper is to describe the methods used to incorporate peer learning into courses within two distinct agricultural disciplines at a satellite teaching program.

The Program

In 1998, an undergraduate and graduate teaching program was established by the University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) at the Indian River Research and Education Center (IRREC). The center is located in a major agricultural production region located approximately 200 miles from the main campus. The program provides students the opportunity to pursue a UF/IFAS Bachelor of Science degree in either Horticultural Sciences or Food and Resource Economics (Agribusiness Management specialization) locally at a satellite campus. Enrollment in the program has grown from 29 students in the first semester (Fall 1998) to the current enrollment of 84 students (Fall 2000) and simultaneously, the proportion of degree-seeking students has steadily increased. Students in the program, both degree-seeking and non-degree seeking, are very goal-oriented and focused on practical applications of the material presented.

Despite program growth, IRREC classes in horticulture and agribusiness currently remain much smaller than courses taught on the main campus and the student: teacher ratio at the satellite campus is still considerably lower (6.6 students on average per class). While extensive efforts are directed towards increasing student enrollment, the current small classroom size at IRREC has created some unique opportunities to utilize innovative teaching techniques in the classroom. Demands from students and future employers for enhanced critical thinking skills and a new, expanding, teaching program have afforded faculty the opportunity to structure their classes around a number of active learning techniques, including peer learning. As the IRREC program continues to grow,

these techniques, currently used in small classrooms, can be adapted to larger classrooms by placing students in groups.

Incorporating Peer Learning in the Classroom

A variety of teaching techniques can be used to optimize the advantages that a non-traditional, satellite program offers (Tignor and Wilson, 1999). The most effective method of teaching depends on the goal, the student, the content, and the teacher (McKeachie, 1994). Given the goal of enhancing student retention and comprehension through active learning and the character of the students in the IRREC program, two faculty members decided independently to capitalize on small classroom advantages and incorporate peer learning as a tool for critical thinking. Peer learning was utilized as a form of active and collaborative learning whereby methods were used to give students more responsibilities than simply listening to lectures and new knowledge and new communities were developed within nonstandard conversations among peers (Rinehart, 1999). In an effort to include peer learning activities in the classroom, changes were made in undergraduate Plant Propagation, and Food and Agricultural Policy courses. Although the specific assignments varied between the two courses, both incorporated elements that allowed students to learn not only course-specific material but also broadly applicable critical thinking skills from each other.

There were multiple goals of the specific assignments including increases in:

1. Ability to understand and evaluate complex subject material;
2. Oral communication;
3. Enthusiasm for the subject matter;

4. Self confidence; and
5. Classroom interaction.

Plant Propagation

Plant propagation is a required, upper-level course for Environmental Horticulture and Horticultural Sciences degree programs. This course is comprised of lecture and laboratory material. The overall objective of the course is to enable students to acquire a comprehensive knowledge of the science of plant propagation including the effects of plant physiological reactions, anatomical structure, and environmental influences on material used for propagation. In addition, students develop a skill in the art of plant propagation during the required laboratory portion of the class. To fulfill these objectives, critical thinking is encouraged through class discussions, outside reading assignments, outside projects, and field practice. Through these exercises, it is intended that students develop an interest, understanding, and appreciation of the principles and techniques of plant propagation.

At the beginning of the semester, students were informed that 20 percent of their grade would be based on performance giving a lecture to the class. Students were allowed to creatively choose their lecture topic with the general restriction that it must relate to propagating plants (Table 1). Two weeks after selecting their titles, students were asked to turn in an outline of the lecture and to make an appointment to discuss the outline with the instructor. At this time, each student was given interesting reference material pertaining to their chosen subject. These private discussions were used as an opportunity to help guide students in the right direction and to encourage the students by showing a personal interest in their topics. Students were evaluated based on the

following ten criteria: organization, preparation, use of visual aids, knowledge of the subject, professionalism, lab demonstration, enthusiasm, use and distribution of reference materials, ability to explain the subject, and creativity. In addition, one question was derived from each student presentation and incorporated into the final exam. At the end of the semester, students were given a separate evaluation sheet designed specifically to obtain feedback from peer teaching classroom activities (Table 2).

Food and Agricultural Policy

Food and Agricultural Policy is a restricted elective course in Food and Resource Economics. Students are required to take one senior-level policy course as part of the core curriculum, and may choose additional policy courses as selected electives. A specific objective of the course is to provide students with a framework to analyze the economic consequences of current and proposed government policy alternatives. Emphasis is on policies and programs affecting the production, distribution, and consumption of food and fiber products, particularly within the state of Florida. Attention is devoted to federal agricultural programs, state and local land use issues, water management, labor policy, and food safety and nutrition.

In the syllabus, students were informed that 20 percent of their grade would be based on a project focused on an agricultural policy issue of their choice. Agricultural policy was defined in a very broad sense that allowed students to choose from a wide range of topics (Table 3). The project was completed in three-stages with classroom presentation and feedback from other students and a written report due at each stage. In

addition, questions were included on the midterm and final exams that related to topics presented by students.

Stage-one required students to select and define a policy issue they wished to investigate. Due dates were early in the semester and the only requirements were that the issue selected should be important to the student, timely and significant on a local and/or national level, and related directly to some policy, law, or legislation. Students were encouraged to visit with the instructor in order to focus their choice of topic and receive reference material and/or contact information if needed. Classroom presentations at the end of stage-one were very informal with each student leading the discussion about why they chose their topic and what they expected or hoped to discover in their investigation. Questions and feedback from fellow students during the discussion helped refine topic selection, often through identification of alternative perspectives.

Stage-two required students to prepare an objective answer to the question “what are the expected impacts from this policy decision.” Students were given eight weeks to complete the task which included the majority of the information gathering and analysis portion of the project. In order to avoid procrastination and to maintain peer learning, students were asked to share with the class one article or piece of information each week that related to their policy issue. At the beginning of most class periods, there was time designated for students to discuss their topics and the information they were finding. At the end of stage-two, each student turned in a written report that provided an objective evaluation of the policy issue they had selected. Each student also made an oral presentation to the class which provided information regarding the policy development, identification of the major arguments concerning the policy and the major proponents of

each view, and the anticipated economic effect of alternative policy outcomes. Reaction and questions from classmates provided an opportunity to expand on the presentations and provided guidance for revisions.

Stage-three of the project involved higher-level cognitive skills. Based on the policy analysis developed in stage-two, each student was asked to make a policy recommendation that included justifications and a response to potential alternative positions. In this phase students were allowed to inject some subjective reasoning into their arguments. Again, oral reports were presented to the class and written reports were turned in to the instructor. The written reports included material and revisions from earlier phases based on classroom discussion.

Response to Peer Learning Exercises

At the end of the semester, response to the peer learning exercises was elicited from a variety of sources: standard student evaluations of the overall course, anonymous student responses to specific enquiries about peer learning, and instructor evaluation of student performance in both the peer learning exercise and the overall course. Student response and instructor observations are summarized in relation to the specific objectives listed above.

Ability to Understand and Evaluate Complex Subject Material

It has long been recognized that a deeper comprehension of material is achieved through teaching it to others. McKeachie (1994) argues that one of the bottlenecks in education is not a lack of thinking, but rather a lack of communication about individual

thinking that allows students regular interaction and feedback necessary for their thoughts and comprehension to evolve. In the peer learning exercises, there were many formal and informal opportunities for students to discuss their selected topics with each other throughout the semester. Questions from other students and the instructor generated lines of enquiry that were not always envisioned at the beginning of the exercise. As a result, the final presentations included a more complete evaluation of the complex topics that were undertaken.

In their formal presentations, students displayed good teaching practice by effectively complementing their lecture assignments with three basic components: content, social context, and presence (Prothero, 2000). In the Plant Propagation course, content was presented through powerpoint slides, overhead transparencies, or the chalkboard (Table 1). These were optional elements for presentations in the Food and Agricultural Policy course. Again, in Plant Propagation the element of social context was incorporated by various laboratory exercises where students could interact during hands-on activities (Table 1). The element of presence was displayed by facilitated interactions between peers both in and out of the classroom.

Oral Communication

Students were initially nervous about speaking in front of the class. It was explained to them that as long as they were prepared and organized, their lectures would go smoothly and there was nothing to be nervous about. Fuhrmann and Grasha (1983) emphasize that both short and long-term memory can be expanded if information is categorized in a meaningful way. Similarly, presenting subject material in a well

organized, well structured manner facilitated the delivery of information and increased communication and understanding in the class. When asked if they felt the lecture assignment helped develop their public speaking skills, all students responded positively, and one student stated, “yes, it helped me overcome my fear of speaking in front of a group.” Students quickly became accustomed to asking, and answering, questions in the classroom and were much less hesitant to speak out.

Pollio (1984) reported that students are not paying attention to what is being said in a lecture 40 percent of the time. When students were asked, “by listening to lectures given by other students, do you feel that you learned more, less, or the same as you would have if the professor lectured in her routine manner” students generally felt they learned more. However, one student clarified “that depended on the individual giving the lecture; for the hands-on part in the lab, I feel I learned as much as if you (instructor) had given the lecture.”

Enthusiasm for the Subject Matter

The novelty of peer learning appeared to greatly increase interest and participation in both classes. Students were able to delve more deeply into a particular component of the course that interested them and were also able to direct the explorations of other students through frequent questions and reports on their findings. Classroom structure directed towards active learning often results in less breadth of subject matter covered formally by the instructor (McKeachie, 1994). Incorporating peer learning into the list of activities allows some of this coverage to be regained. Perhaps more importantly, peer learning allows the class material to be tailored to the particular

students' interests. The instructor can use other elements of the class to present fundamental concepts and tools of analysis. Peer learning topics presented by the students then become concept applications incorporated into the course.

As an individual student's enthusiasm for their topic grew, they were often able to transmit that to their classmates. By choosing the topics, the students had an inherent interest. Peer learning forced them to teach those topics to others, often incorporating information they would not normally have considered in order to answer questions and provide a comprehensive assessment. In addition topics chosen which were initially viewed with skepticism by fellow-students often became intensely debated as the class learned more about the issues and how they were impacted. One example of such a topic was taxation of internet transactions, at first regarded as outside the bounds of an Agricultural Policy course by many students.

Self Confidence

Over the period of the exercise, most students made a transition from being apprehensive and hesitant to self confident and relaxed, both about their understanding of the material and their ability to present information to, and answer questions from, their peers. The instructors appeared to serve as role models by which students framed their lectures. Forsyth and McMillan (1991) emphasize that instructors who show interest in the material, display a scholarly attitude while teaching, and genuinely care about being understood, are more likely to produce students who also display these values.

Enthusiasm and confidence displayed by the instructor during lecture and individual

students during their presentations were contagious to their classmates and mimicked in subsequent presentations.

In the Food and Agricultural Policy course, the growth in confidence often involved motivating students to think through their preconceived beliefs about a topic and evaluate the opposing arguments. Students didn't always reach a different conclusion at the end of the semester, but they significantly strengthened their own analysis. Often students were shocked at the complexity of issues where they held some strong *a priori* opinions. In the evaluation, one student noted the "assignment forced me to think from a side I would not normally consider."

Classroom Interaction

The peer learning exercise helped facilitate classroom interactions between students as well as between students and instructors. Although peer learning involves students teaching to, and learning from, each other the instructor continues to play a critical role. Student-instructor contact remains necessary and important for effective peer teaching and learning (Sorcinelli, 1991). Occasionally it was necessary to facilitate the lecture by clarifying misinformation, asking probing questions, ensuring adherence to the task, and ensuring participation. However, for student led lectures to be successful, the role of the instructor is to listen to the students and not dominate the discussion Collard (1994). The instructor must respect students as thinkers and learners, thereby allowing them the freedom to search for answers. Forsyth and McMillan (1991) add that it is important for the instructor to understand what students perceive as important and interesting and stress the importance of students' involvement in meaningful learning.

Formal and informal student-interactions were also increased through peer learning. In the Plant Propagation class, students were asked to announce their lecture titles to the class several weeks prior to the assignment due date. While this was initially done as an effort to avoid overlapping subject material, it later proved beneficial as students began to actually help each other with their topics by sharing references, plant material, and ideas. The students began to work as a team to strengthen each individual lecture. In addition, frequent interactions within the class as students developed and discussed material created a more relaxed atmosphere, which greatly facilitated discussion in other elements of the course as well.

Conclusions

Peer learning is an important technique for developing critical thinking skills among students in a variety of agricultural disciplines. Employers are increasingly demanding students who can analyze and evaluate events as opposed to rote repetition of established “facts” or theorems. The rapid evolution of new ideas and the ever-expanding amount of information available in today’s society continue to increase the importance of such skills.

Two courses at a University of Florida satellite undergraduate teaching program were independently modified to incorporate peer learning exercises. Although the courses addressed very different subject matter, the goals of the exercise developed critical thinking skills that crossed disciplines. Implementing peer learning in the classroom enabled students to better understand and evaluate complex subject matter. Oral communication skills, enthusiasm for the subject matter, self-confidence and

classroom interaction improved as a result. Students were supportive of the peer learning activities and felt they had gained from the experience compared to only instructor-led traditional lectures.

In addition both instructors had favorable reactions to incorporating peer learning. An important benefit was the ability to tailor course material to the specific interests of the students. The instructors used specific elements of the class to present fundamental concepts and tools of analysis. Peer learning topics selected by the students became a guide to direct presentation for applications of these concepts. While the role of the instructor was to listen to the students and not dominate the discussion, it was necessary for the instructor to remain actively involved in each of the topic areas to clarify misinformation, ask probing questions, and ensure participation.

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Table 1. List of lecture and laboratory presentations given by students in Plant Propagation (PLS 3221C), Fall 1999.

Lecture topic	Lecture Style	Features	Laboratory Exercise
Bromeliads -History -Taxonomy -Ecology -Propagation	Power point slide show	-Slide show of bromeliad display at Fairchild Tropical Gardens -Book display of several bromeliad references	-Removing and potting bromeliad pups -Designing and installing a bromeliad tree
Geophytes -Classification -Anatomy -Physiology -Propagation	Power-point slide show	-Series of handouts provided on propagating various bulbs	-Scooring and scooping hyacinth bulbs -Removing cormels from gladiolus corms -Sectioning tunicate bulbs
Loquat -Origin -Cultivation -Physiology -Propagation	Color transparencies	-Fruit tasting -Loquat jam recipe -Hard copies of powerpoint slides	-Air layering loquat using two different techniques -Propagating loquat from seed
Zingiberales -History and nomenclature -Rhizome culture and care -Examples and experience -Propagation	Power-point slide show	-Slide show of many banana varieties "Going Bananas" Nursery -Diagrammatic representation of Musa and their relatives	-Dividing heliconias, gingers, cannas
Cacti -Succulents and their habitat -Biological adaptations, anatomy -Botanical classification -Propagation	Chalk board	-Handouts -Display of reference material -Pictures of cacti national park in Arizona	-Flat grafting several kinds of cacti -Generative propagation by seed
Bamboo -Historic and modern uses -Classification -Botany, culture -Propagation	Power-point slide show	-Book display of several bamboo references -Hard copies of powerpoint slides	-Propagating numerous bamboo species by divisions, air layering, and culm cuttings
Palms -History -Nomenclature -Culture -Propagation	Chalk board	-Handouts - Large palm inflorescence -Book display of several palm references	-Cleaning, soaking, scarifying, and planting palm seeds of various species

Table 2. Evaluation designed specifically to obtain student feedback from peer teaching classroom activities.

1. Do you feel that the student lecture portion of the class was time well spent in class?
 2. What was your reaction to the other lecture/lab presentations?
 3. By giving a lecture of your own, do you feel that you learned more, less, or the same as you would have if the professor lectured in her routine manner?
 4. By listening to the other student lectures, do you feel that you learned more, less, or the same as you would have if the professor lectured in her routine manner?
 5. Besides learning more about a certain subject of propagation, did giving a lecture yourself help you develop in other ways (i.e. public speaking, organization, professional development, etc.) that you can use in the future?
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Table 3. List of peer learning projects undertaken by students in Food and Agricultural Policy (AEB4224), Fall 1999.

Policy Area	Issue Investigated	Features
Agricultural Labor	Federal guest worker legislation	Current federal legislation (H-2A) and its proposed reform (Agricultural Job Opportunity Benefit and Security Act of 1999) from the agricultural employers and workers perspectives.
Water Use	Indian River Lagoon and St. Lucie Estuary management	Role of the South Florida Water Management District and its proposed changes for local water management including the Aquifer Storage and Recovery System and the Save Our Rivers Project.
Pesticide Use	Applicator Licensing	Need for licensing and historical development of state legislation including past and current interest group positions.
Wastewater Treatment	Agricultural Use of Treated Wastewater	Current conflicts between local, regional, and state agencies over control and regulation of wastewater treatment and use.
Taxation	Internet Taxation	Deliberations of the federal Advisory Commission on Electronic Commerce and its impact on internet transactions in food purchasing.

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