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Written Assignments to Improve Critical Thinking

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Introduction

We teach in the Department of Animal and Range Sciences at Montana State University-Bozeman. The combination of animal and range sciences is unique in the Western United States. Agriculture represents the largest economic sector of the economy in Montana (Montana Agricultural Statistics Service, 2002). Within that sector, beef cattle comprise the greatest contribution to the state's economy (Montana Agricultural Statistics Service, 2002). Most beef cattle producers are cow-calf operators who utilize rangelands as their primary forage source. Almost 70% of the state is comprised of rangelands or grazeable woodlands (Ross and Taylor, 1988). Therefore, it is important for our students to understand how to produce beef cattle under our environmental conditions in a manner that is sustainable.

Our department tries to emphasize the importance of using knowledge to solve problems. Most of the successful producers in our state are excellent examples of sound critical thinkers. They gather information, focus on problems, and attempt solutions which are sustainable and cost effective. We believe our teaching approach is reflective of the people we serve. Most of our teaching materials are selected on the basis of how they could be used to solve the most common problems. The Department of Animal and Range Sciences has concentrated on the applied nature of our disciplines. The producers in our state have to be resourceful in order to stay in business. They have discovered a number of solutions to difficult problems which are not printed in any textbooks. Some of our progressive operators subscribe to scientific journals and a number of on-line sources. They keep themselves informed and look for ways to use this knowledge to advance their enterprise. One key to their success has been their ability to critically evaluate problems and craft solutions.

The purpose of our writing assignments is to push students to find information that can be used to answer common problems associated with animal and range sciences. When those solutions are communicated to others, it is possible to examine the thought process that developed the answers. By giving repeated problem oriented assignments, students begin to examine their reasoning and benefit from listening to students who exhibit strong critical thinking skills. We further believe that all students in our disciplines should become familiar with the scientific literature related to their discipline. When a student graduates, they will be expected to have a command of the technical information in their fields. Their credibility will be tested when they try and help someone who knows the literature better than they do.

Writing Assignments

For this paper, we have organized the two types of writing assignments by the courses we teach. The first is used in a junior level animal science nutrition course. The assignments consist of a series of problems which ask students to solve common nutritionally related questions in the state. The second set of assignments, for a junior level class, is designed to have students answer problems common to rangeland management.

Nutrition Challenge

The Nutrition Challenge is a biweekly written assignment designed to encourage students to find answers to a practical livestock nutrition problem or to formulate current information on a topic using the scientific literature. A practical nutrition-related topic is presented in class. These topics come from actual extension questions asked by producers, or from nutrition-related topics of current interest. Students have two weeks to gather information and formulate their recommendations or conclusions. Possible solutions and recommendations are discussed in class on the due date for the assignment. Students are encouraged to use many sources of information, such as personal interviews, Extension Guide sheets, and Internet searches. They must include at least one scientific literature source for a “C” grade. An “A” paper requires a minimum of five sources of information, with a minimum of three scientific journal articles. The paper must be original, independent work by the student, and can be no more than one page in length. The grading criteria are:

1. Format – if not correctly followed, 0 points.
2. Introductory paragraph with purpose identified – 5 points
3. Correct details and specific information, well-organized – 20 points
4. Summary of important points – 5 points
5. Proper format for Literature Cited – 5 points
6. Information sources used – 10 points
7. Language, correct verb tense, complete sentences, correct spelling – 5 points

Students may need some guidance in getting started finding appropriate sources of information, especially in regards to the scientific literature, with which they may be unfamiliar. This usually necessitates office visits with the professor and allows one-on-one exchanges to take place. This provides the setting to introduce the idea of evaluating the credibility of sources. Subsequently,

students are often overheard working together and exchanging ideas about whether or not particular sources would be considered credible or biased, and about other available sources of information. This student-to-student learning enhances the critical thinking process. Having to explain their logic and thinking processes to another student requires a solid understanding of their approach. Limiting the assignment to one page requires students to choose only the most important information and requires them to stick to the topic in question. This compels them to be extremely selective in the sources of information they choose, thus enhancing the idea of critical evaluation of source material. It also requires that they synthesize and condense the material, producing a deeper understanding of the topic. The class discussion of the topic requires that students express their reasoning and defend their ideas orally. In addition, they have the opportunity to hear and critique the different approaches to the problem taken by other members of the class. Finally, students are presented with the concept that there are often multiple legitimate solutions to a problem and are given practice in critically evaluating not only the various solutions, but also the logic and process that led to their discovery.

Student enthusiasm for the assignment has been very strong, and ideas from students are routinely used for new Nutrition Challenge problems. The original intention with this learning activity was to encourage students to investigate a problem on their own, to expose them to a wide variety of possible resources, and to encourage inquiry habits that would continue into life-long learning. It has been a very successful, and popular teaching tool.

Range Management

Students are asked to select a current problem in range management related to the general test material which will be covered in a third of the class meetings. Three papers are required per semester. All problems must be discussed and approved by the instructor prior to any other assignments. Students with a strong desire to examine other topics may be permitted if they can demonstrate the topics meet the objectives of the assignment. Topics which have virtually no scientific literature are discouraged unless there are a host of other sources. The grading criteria for the papers are given at the beginning of class.

Once the students have an approved topic, they are asked to bring in five references on the subject. At that time, we spend a class discussing the validity of different information sources. That is followed by another class period which examines the scientific method, rules of evidence in science, and scientific journals. Later, we will have a writing workshop where they have to bring in their topic paragraph to read to the class. We examine the strengths and weakness of these paragraphs and they get a small taste of being a critical thinker and how to evaluate ideas using scientific rigor.

The next workshop centers on an exchange of papers. They are asked to grade each other's papers. Students usually learn that their solutions will not be used if they cannot communicate their ideas to others. Unclear communication is often due to the lack of understanding. This step illustrates the need to understand concepts before the evaluation makes sense.

The process is repeated for two more papers except the preliminary workshops are eliminated for the final paper. Repetition is important to demonstrate the basic questions used in critical thinking:

1. What are the claims of this idea?
2. Is there any evidence to support these claims?
3. What is the quality of the evidence?
4. How do these findings relate to other studies or ideas?
5. What is your evaluation of these claims?

(adapted from Ford, 1998)

With some help from the instructor, students begin to see the value of rational thought and disciplined thinking. They also learn the value of being creative to find solutions. We may bring in ranchers who are creative problem solvers. The students are surprised to see the depth of their knowledge on a variety of subjects. Their creative solutions are usually the result of disciplined thinking based on sound evidence. They realize that successful people in the ranching industry must be life long learners if they are to stay in business. The value of these assignments is reinforced when someone from the outside the classroom demonstrates the level of skills we are trying to develop.

The grading criteria emphasizes the elements of critical thinking (Paul, 1993) above what many students assume to be correct answers. When we review the solutions in class, students can see there are multiple solutions. The keys to these solutions are based on subject knowledge. Subject content is evaluated. The final area of grading deals with the presentation of ideas in a manner that is easy to understand. Papers must follow a prescribed style and format so the whole class has one standard. If their solutions are not presented in an organized manner they will not receive high marks regardless of the content.

We do not have any quantitative data to address the effectiveness of these exercises to improve critical thinking skills. We can offer some subjective comments based on the grades of the papers. By the end of the semester, one third of the class has developed a good understanding of the main elements of critical thinking and effective communication. By the end of the second semester, two thirds of the class has developed sound critical thinking skills.

Based on subjective mid-course evaluations (Coffman, 1991) of 9 classes, the majority of the classes (7 of 9) believed the writing assignments improved their ability to think. In two classes, the majority of the students viewed the assignments as “English papers” or “technical writing” that was not relevant to their education.

Summary

We have attempted to design written assignments which require students to use critical thinking to solve problems. The grading criteria emphasize the fundamentals of sound thinking over a “correct solution”. We believe these types of assignments will encourage students to improve their thinking skills and demonstrate why solving problems requires an understanding of the subject matter.

Literature Cited

- Coffman, S. J. 1991. Improving your teaching through small-group diagnosis. *College Teaching* 39(2) 81-82.
- Ford, B. 1998. Critically evaluating scientific claims in the popular press. *The American Biology Teacher*. 60(3) 174-180.
- Montana Agricultural Statistics Service. 2002. Cash receipts from marketing commodities, selected years, Montana, USA. <http://www.nass.usda.gov/mt>
- Paul, R. W. 1993. Critical thinking-how to prepare students for a rapidly changing world. Foundation for Critical Thinking, Santa Rosa, CA.
- Ross, R. L., and J. E. Taylor. 1988. Rangeland resources of Montana. *Rangelands* 10:206-209.

ARNR 353
Grazing Ecology and Management
Written Assignments
Bok Sowell

Assignment:

Select a current management problem associated with grazing (livestock or wildlife) and formulate a solution based on the scientific literature. This assignment is not a topic related term paper where you describe something. It must be a management problem that resource managers are concerned about today. All topics must be approved in advance after consultation with the instructor. Examples: Prescribed burning to change plant communities; rest-rotation grazing to enhance elk habitat; deferred rotation to enhance trout populations, etc.

Learning Objectives:

1. Improve the element of sound reasoning and critical thinking.
2. Improve students' ability to solve problems.
3. Introduce students to the scientific journals used in their area of study.
4. Improve students' ability to communicate with others.

Due Dates:

9-4 First day of class
9-5 Topics approved by this date
9-9 Topic paragraphs due and discussed
9-23 Draft of paper #1 due-discussed and graded
9-30 Paper #1 due
10-14 Topic #2 approved
11-4 Rough draft of paper #2 due
11-13 Paper #2 due
11-20 Topic #3 approved
12-9 Paper #3 due

Grading Criteria: See handouts