

# In-Class Exercises to Improve Learning In a Lecture Class

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### Abstract

*Every lecture period in an introductory crop science course was interrupted with a 5 minute exercise about half way through the class period. Each exercise asked questions about topics covered in class or in the textbook. Students were allowed to use notes and the textbook to answer the questions and were encouraged to work together. The exercises were briefly reviewed after collection. Students were given 3 points for correctly completing the exercise, 2 points for incorrect work, and 0 points if absent. Up to 100 points can be accumulated during the semester, which is worth half the value of an hour exam toward the course grade.*

*Comparisons between classes that were given the exercises and classes previous to the implementation of the exercises showed that there were significant increases in class attendance and final exam scores. This suggests that learning and retention of course material increased when the exercises were used.*

### Introduction

A recent survey of crop science courses at 49 universities showed that 92% of these courses were taught using a lecture format of 45-50 minutes (Karnok and Conners, 1986). Another study by Vietor (1985) using a cognitive interaction analysis system to track activity in lecture classes showed that over 90% of a lecture class was spent in teacher talk. A study of the personality types of agriculture students by Barrett (1987), found that 75% of the students surveyed were oriented to practical learning. These results suggested that these students preferred to apply information received in class to immediate or practical use. Furthermore, these students preferred more direct learning methods and had less skill and interest in abstract concepts often presented in a lecture format.

Many studies have shown that the lecture format is an efficient way to deliver large amounts of information; but, it is not always conducive to effective learning. Fulkrod (1986) stated that lecturing is not effective in fostering abstract thinking in students and helping them grasp interrelationships between topics. Verner and Dickinson (1967) showed that the lecture can be used to introduce and create interest in a topic; however, it is not effective when the

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educational goals move to higher cognitive levels of application, synthesis, and analysis. Knight (1988) stated that the time has come to move beyond teacher-centered instruction and promoted the use of student-centered instruction.

Anderson and Harrison (1985) reported that they interrupted some lecture classes to administer short quizzes, review course objectives, evaluate teaching techniques, or conduct short discussion sessions. Student reaction to these activities was highly favorable.

This paper discusses a method in which every lecture class was interrupted with a short exercise in which the students worked together to answer questions about the material presented in class or in the textbook. The method was similar to a feedback lecture reported by Osterman (1982), in which every lecture period was divided into two 20-minute lectures separated by a 5-8 minute discussion period in which students discussed questions in groups of two.

### Procedure

Agronomy 101, Introductory Crop Science, is a four credit course consisting of three, 50-minute lectures and one, 2-hour laboratory class each week for 15 weeks. Its format and content are similar to other introductory crop science classes taught at other universities (Karnok and Conners, 1986). The lecture part of the course meets 45 times every semester. There were four, one-hour exams and 41 lecture periods during the study. Until fall semester, 1987, a standard lecture format was used. Beginning in the fall semester, 1987, each lecture was interrupted with an exercise which occurred about 20-25 minutes into the lecture period. Students were given about five minutes to complete the exercise after which their answers were collected and the exercise was briefly discussed. The remaining class time consisted of additional lecture.

Each exercise contained one or more questions pertaining to the topic just covered, a topic covered in the previous lecture, a topic that would be covered in the second part of the lecture, or a topic not discussed in lecture but which was covered in the textbook. Exercises consisted of short answer, essay, and completion questions. No multiple choice questions were used.

The questions ranged from lower to higher cognitive levels. Using the vocabulary guidelines proposed by Newcomb and Trefz (1987), most of the questions were at the Remembering and Processing levels, and about 25% were at the Evaluating level. There were no questions at the Cre-

ating level. Examples of questions at each level are shown in Table 1.

Students could use their notes or textbook to complete the exercise and were encouraged to work together. Although no formal groups were designated, most students worked with others nearby and some completed the exercise alone.

Each exercise was worth three points if completed correctly. Students who incorrectly completed the exercise were given two points. Students who were absent from class received a zero. There were no opportunities for making up missed exercises.

Points from the exercises were accumulated during the semester. There were 41 exercises, or 123 potential points but students could not accumulate more than 100 points. Therefore, a student could miss up to seven class periods without a penalty. The points accumulated from the exercises were worth one-half as much as an hour exam or the equivalent of one-sixteenth of the total course grade.

## Results and Discussion

A total of 274 students have enrolled in the course during the three semesters the exercises have been given (Table 2). There was a gap of one academic year when the author was on sabbatical leave. Performances of 258 students enrolled the three semesters before the exercises were used were compared with those who were given the exercises.

Class attendance considerably improved with the use of exercises, increasing from an average of 78% to 87%. This improvement in attendance was probably due to the fact that the use of the exercises also resulted in checking attendance, as well as the grading penalty incurred if less than 100 points were accumulated. However, students could miss up to 7 class periods (15.5% of the total) without penalty. An average of 73% of the students that were given the exercises received full credit of 100 points. Over 85% of the students received 90 points or more which was equivalent to an "A" grade in the course.

The same comprehensive final exam with only minor revision was given in all six semesters. The exam was not returned to the students and careful security was maintained to assure that no copies were available. The average score of the final exam for students who were given in-class exercises was 78%, compared with 73% for those not given the exercises. Statistical analysis using a Student T-test of the final exam scores showed a significant increase ( $P < 0.01$ ) in exam scores when the students were given the exercises.

The increase in learning was probably due to several factors. First, the attention of the students during class was increased when the lecture was stopped and they actively participated in completing the exercise. Second, completing the exercise reinforced the material presented during the lecture. Third, the use of higher cognitive questions on the exercises increased student understanding and comprehension of the topics presented. Fourth, peer-group teaching was incorporated which probably helped those who worked in groups. Fifth, the use of exercises increased class attendance.

**Table 1. Examples of questions used for in-class exercises at various cognitive levels.**

Cognitive Level	Question
Remembering	List four kinds of losses from weeds and give an example for each.
Processing	Briefly explain the differences between mitosis and meiosis.
Evaluating	We are faced with tremendous surpluses of most grain crops. Decide if it would be advisable to discontinue crop breeding projects for a while to save money. Defend your answer.

Unsolicited comments by students during course evaluations were very positive. Only a few mentioned that they did not like the exercises or thought that they were a waste of time. Students seemed to welcome the break from the lecture; and since they were able to use their notes and each other to help complete the exercises, the exercises were perceived to be relatively non-threatening.

There were disadvantages to using the exercises which were mostly related to demands on the instructor's time and organization. First, use of the exercises forced the instructor to divide the topics presented in lecture into segments with logical stopping points. Time needed for questions and class discussion became more difficult to predict and accommodate when a lecture was only 20 to 25 minutes long. Second, there was less time for presenting material since each exercise took 8 to 10 minutes to distribute, complete, turn in, and discuss. Third, the time needed to grade the exercises and record the scores was substantial in a course with a large enrollment. Not all exercises were graded. In those cases, students received 3 points if present. This was particularly true of exercises which evaluated higher cognitive skills. Assistants were used to help grade papers and record scores.

## Conclusion

The use of 5-minute exercises about half way through a lecture class improved student attendance and learning. The exercises were received positively by most students as a welcome break from the lecture routine and a chance for review of topics presented in lecture. Mid-class exercises can be an effective learning tool for students.

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**Table 2. Class attendance and final exam average of students with and without the use of exercises within a lecture class.**

Semester	N	Class Attendance (%)	Final Exam Average (%)	100 Points From Exercises (% Students)
With In-class Exercises				
Fall 89	98	86	79	72
Spr 88	88	86	76	76
Fall 87	88	88	78	71
Total	274		Avg. 78	
Without In-class Exercises				
Spr 87	76	78	74	
Fall 86	91	76	73	
Spr 86	91	80	73	
Total	258		Avg. 73	

# Readability of Required Undergraduate Agriculture Textbooks

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Textbooks play an important role in most undergraduate agriculture courses. Many instructors identify one or more required course textbooks and expect their students to supplement classroom and/or laboratory instruction by completing designated reading assignments. According to Ornstein (1989), textbooks have a profound affect on student learning experiences.

Given the importance of textbooks in the teaching and learning process, the selection of appropriate textbooks should be of utmost concern to agricultural educators. Wood and Rosati (1990) studied the methods which university agricultural mechanics faculty used to select introductory course textbooks. The researchers found that informal methods such as recommendations from colleagues, tradition, and publisher recommendations were most commonly used. According to Wood and Rosati (1990, p. 3), "Few instructors at the post-secondary level use empirical measures when selecting textbooks."

One factor which should be considered in textbook selection is readability. By definition, a well-written textbook should be readable. A textbook which expresses ideas and concepts in simple, everyday language is a readable textbook (Davison, 1986).

Unfortunately, readability is an often neglected factor in textbook selection (Wood and Rosati, 1990). For example,

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Chavez, Reneau, Legacy and Stitt (1983) determined that the mean readability of agriculture textbooks used in one community college was higher than the mean reading level of the students enrolled. In such circumstances, textbooks may actually hinder student learning.

It should be noted that reading grade level is not the only factor affecting readability. Readability formulas are not designed to determine how interesting a section of text will be. However, as stated by Thorndike (in Wittrock, 1986, p. 830), "Books do not have to be bad literature; but the vocabulary and sentence structure must not thwart comprehension of what the book tells, and that must be something that the pupil cares to be told."

## Purpose and Objectives

The purpose of this study was to determine the readability of textbooks required in undergraduate agriculture courses at Mississippi State University during the Fall 1990 semester. Specific objectives were to:

1. determine the overall readability of textbooks required in undergraduate courses;
2. determine the readability of required undergraduate agriculture textbooks by academic department;
3. determine the readability of required undergraduate agriculture textbooks by course level (as indicated by course number); and
4. determine the relationship between textbook readability and course level (as indicated by course number).

## Procedures

The official university course schedule was used to compile a list of all undergraduate agriculture courses offered during the Fall 1990 semester. Examination of the course schedule indicated that 126 courses were offered during the period (excluding Special Problems courses). Through consultation with individual course instructors and the manager of the university bookstore, 73 different required undergraduate agriculture textbooks were identified. Each of these 73 textbooks was evaluated for readability.

The Gunning-FOG Index (Gunning and Mueller, 1981) formula was used to estimate textbook readability. The formula is used to calculate readability (reading grade level) based on average sentence length and percentage of polysyllabic words per 100 word passage. When using the Gunning-FOG Index, low scores indicate more easily readable text while high scores indicate harder to read text.

The Gunning-FOG Index (Gunning and Mueller, 1981) formula was selected for use in this study due to its adaptability for calculation by computer. Although other formulas