CASE STUDY

Knowledge Acquisition In Plant Science

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Abstract

Assessment of student performance (change in understanding) in an introductory plant science course was measured in terms of grade level, declared major, and difference between pre- and posttest score. The effect of pretesting on posttest performance was examined.

The average growth in understanding of plant growth and development concepts during the semester was 34.5 percent. Pretesting did not influence the posttest scores, which indicated that the research design was an unbiased measure of growth in understanding. Freshmen, sophomore, junior, and senior students enrolled in the Introductory Plant Sciences Course did not perform significantly different as measured by posttest scores. Student performance was not affected by major in the College of Agriculture.

Introduction

Teachers have historically been concerned with their effectiveness in changing student behavior (4). Questions are often asked as to the effect of teaching environment, student background, and student purpose upon the relative degree of change which might be expected to occur in a classroom (1, 2). These concerns are very realistic in terms of introductory courses at large colleges and universities. At such institutions, it is common to have one hundred or more students enrolled in a single lecture section. The students might range from entering freshmen to upper classmen and from those majoring in the subject matter area to those who are only mildly interested or worse yet, those who could not schedule another class.

Teachers who have not taught large sections often experience considerable apprehension when required to assume such a responsibility. The apprehension grows out of a concern for what the students are gaining from the lecture (3). The reduction in the interpersonal contacts between the teacher and students undoubtedly contributes to this apprehension. Instructors who teach smaller classes with a less diverse group of students can seek and receive more student feedback. Such feedback provides direction as to student concerns and a relative measure of their achievement or understanding.

Faculty members in the Departments of Plant Sciences and Agricultural Education at the University of Arizona undertook a research project to provide answers to these concerns. The main purpose of this study was to determine the amount of knowledge which a student acquires during an introductory college course, with the intent of using the results to assist in the improvement of objectives, content, and evaluation procedures for that course. The following specific questions were addressed:

1) Will there be a statistically significant change in students' understanding of plant growth and development after one semester's exposure to introductory plant science in a large lecture setting?
2) Will there be a difference in student understanding of plant growth and development concepts between students who received the same posttest as pretest and those who did not?
3) Will there be a difference in the relative change in understanding of plant growth and development concepts between freshmen, sophomore, junior, and senior students completing a one (1) semester course in introductory plant science?
4) Will there be a difference in student understanding of plant growth and development concepts between students majoring in Plant Science and students majoring in other agricultural fields of study?

The answers to questions 1 and 2 should help determine student performance in a large lecture setting and the effect, if any, of pretesting on posttest results.

The latter two questions were concerned with two factors associated with student background and interest and their effect, if any, on student performance in the

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course. Such information might be useful in student counseling and establishment of course requirements.

The authors did not attempt to establish the ideal teaching environment or to measure the effect of all possible background or interest factors on performance.

Methods and Procedure

Shortly after a new course in Plant Science was established at the University of Arizona, the instructor approached the staff in Agricultural Education for assistance in evaluation. The course objectives and content were well defined. The course had already attracted student attention, and enrollment was increasing rapidly. A decision was made to utilize a criterion-referenced evaluation instrument for measuring student understanding (5). This particular format and test design had been used with several hundred vocational agriculture students in Arizona.

Two hundred thirty students enrolled in the Fall Semester of Plant Science 5 at the University of Arizona were randomly divided into two groups. Two pretest examinations were prepared. Test A was designed with multiple choice questions which encompassed 14 areas of Plant Science. These areas ranged from structures of leaves, roots, and stems to basic concepts of physiology, genetics, and taxonomy. Pretest B consisted of management practices involving seedbed preparation, irrigation, fertilization, harvesting, and seed processing.

The control group consisting of 111 students was given the same test (Test A) at the beginning and again at the end of the semester. The 119 students in the treatment group were administered Test B at the beginning of the semester and Test A at the end. Test B was given so as to avoid a Hawthorne effect or alerting students that they were being treated differently. Test B was not related in any way other than similarity of subject to the course content. This technique provided an opportunity to assess the effect of a pretest on posttest performance for a semester course. The date and time for the tests were not announced and students were not warned or provided special opportunities for preparation. Each examination consisted of 56 questions assembled using a random page technique.

The differences in pretest and posttest scores (number of correct responses) for the control group were used to determine the relative change in student understanding as described in specific question #1 and between grade levels as described in question #3. In the case of question #2, a comparison was made between the posttest scores of the control group and those of the treatment group; any differences noted between the two scores might be some indication of the effect the pretest had on the posttest performance of the control group. Posttest scores of the treatment group were used in answering question #4.

Results and Discussion

The mean correct responses for the students in the control group on the pretest and posttest were 31.0 and 41.7, respectively. This represents a percentage correct response of 55 on the pretest and 74 on the posttest. Overall, this represents a 34.5 percent increase in understanding of plant growth and development concepts as measured by the criterion-referenced evaluation instrument. Student understanding was significantly higher statistically at the end of the course (Table 1).

Table 1. Comparison of Mean Correct Responses Between Pre- and Posttest Scores for Control Group (N = 111)

	Mean Correct Responses				
Group	Pretest	Posttest	Difference	Percent Change	t*
Control	31.0	41.7	10.7	+34.5%	-20.56

*P < .001

The question of the degree to which a pretest will influence posttest score is answered with the data in Table 2. As indicated, the posttest score for the control group which had received the same pretest was 41.7 while the posttest score of the treatment group who had not received the same pretest was 40.3. Thus, the students in the control group averaged 74.4 percent correct responses on the posttest compared to 72.0 percent correct responses for students in the treatment group. The calculated t-value of 1.87 was not statistically significant at the .05 level of probability. These data suggest that when questions on pretest examinations are randomized for individual student examinations, students performed no differently whether they had been exposed to the examinations at the beginning of the semester or not.

Table 2. Comparison of Mean Correct Responses on Posttest for Control and Treatment Groups

	Mean Correct Responses		
Group	Posttest	Difference	t*
Control (N = 111)	41.7		
		1.4	1.87
Treatment (N = 119)	40.3		

*P > .05

A comparison of student performance by grade level is shown in Table 3. The number of correct responses on the pretests and posttests were not significantly different for freshmen, sophomore, junior, and senior students. There was no significant difference in student understanding of plant growth and development concepts between grade level, as measured by posttest scores.

Table 3. Comparison of Mean Correct Responses Between Pre- and Posttest Scores of Control Group by Grade Level of Student

	Mean Correct Responses			
Grade Level	Pretest	Posttest	Difference	Percent Change
Freshmen	29.3	41.1	11.8	+40.0%
Sophomore	30.0	41.2	11.2	+37.3%
Junior	33.2	42.9	9.7	+29.3%
Senior	33.4	42.4	9.0	+27.1%
Overall	30.8	41.7	10.9	+35.2%

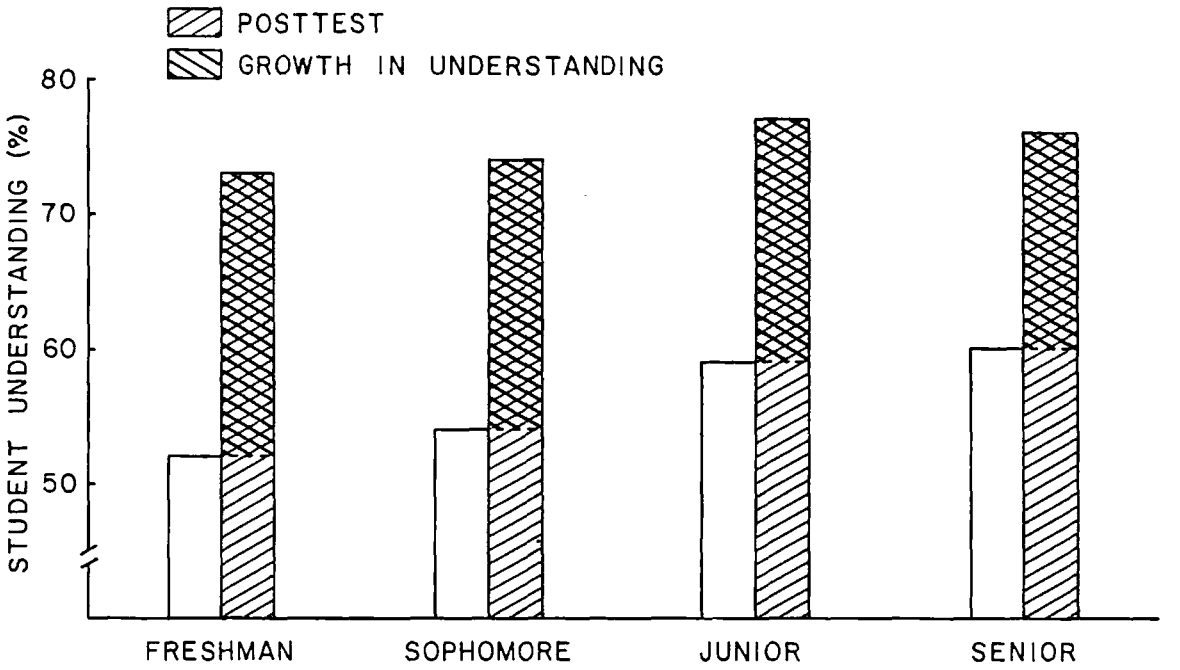

Figure 1

Although **not** statistically significant, the pretest scores tended to increase as grade level increased. In other words, there was a linear relationship between grade level and pretest scores, indicating that upper division students, because of their background and experience, entered the course with slightly greater knowledge than lower division students. Figure 1 depicts the pretest scores and posttest scores and shows the growth in understanding of students at the various grade levels. While students tended to start off with different degrees of understanding, they completed the course with very little difference in understanding. Freshmen students showed the greatest overall growth in understanding while the senior students showed the least.

The question of whether students majoring in a specific subject matter area will perform better in such courses than students not majoring in that subject area is addressed in Table 4.

Table 4. Comparison of Mean Correct Responses on the Posttest by Type of Major for Treatment Group

	Mean Correct Responses			
Type of Major	Posttest	Difference	Percent Change	t*
Plant Science (N = 25)	39.1			
		2.5	+6.3%	-1.63
Agricultural (N = 31)	41.6			

*P > .05

Specifically, the performance on the posttest of Plant Science majors was compared with those majoring in other areas within the College of Agriculture. There was no statistically significant difference in students' understanding of plant growth and development concepts between Plant Science and non-Plant Science majors as measured by posttest scores.

Conclusions

As a result of conducting this study and based upon the findings, the following conclusions were drawn:

1. It is possible to measure relative change of college students' understanding of specific subject matter content as evidenced by the result of the experiment.
2. The use of the same examination for both the pretest and the posttest had little or no influence on posttest scores.
3. Although there was no significant difference on posttest performance by grade level, "lower division students" tended to show the greatest growth in understanding.
4. It was not possible to distinguish between posttest performance of College of Agriculture students based on interest as measured by major. There was no evidence to indicate that one type of major performed any better or poorer than another type of major from within the College of Agriculture.

Literature Cited

1. Burger, A.W. and R.D. Seif. 1975. "Course Performance Versus Background of Students in Beginning Crop Science." *Journal of Agronomic Education*. Vol. 4.

2. Elkins, D. M. and D. W. Lybecker. March 1977. "Teaching Non Farm Students Introductory Field Crops." *NACTA Journal*. Vol. XXI, No. 1.

3. Holloway, R. L. December 1977. "An 'Examination' Model of Instructional Development." *NACTA Journal*. Vol. XXI, No. 4.

4. Kuhns, L. J. June 1977. "Teaching for Permanent Learning." *NACTA Journal*. Vol. XXI, No. 2.

5. McCormick, F. G., P.R. Zurbrick and I. M. Gonzalez. June 1976. *Criterion-Referenced Evaluative Instrument - Plant Growth and Development*. CREI No. 5, Department of Agricultural Education, University of Arizona. 22 pps.