Student response to "hands-on" experience in crop science courses[1]

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ABSTRACT

Students in four plant science courses taught by two agronomy instructors were given a survey questionnaire at semester's end to evaluate their attitude about the hands-on experiences in the course they were completing. Given the opportunity to agree with, be neutral, or disagree with statements about the hands-on experience, three of four students favored courses with laboratories, doing their own plant cultural management work, and collecting their own data. Further, three of four replied that they believed the laboratory was a good learning tool, that additional hands-on experiences would be welcome and would improve their chances in the job market. One-half the students surveyed preferred to participate in the planning of the hands-on activities, and one-third expressed the desire to do original research, rather than repeat known results. The students' willingness to do the tasks associated with the management of the plants used in their studies should be encouraging to instructors who would like to include hands-on experiences in their plant science courses but who have not had access to sufficient resources to accommodate the increased responsibilities associated with hands-on exercises.

Additional index words: **Laboratories, Farm background, Job preparation, Educational resources.**

AGRICULTURAL classes throughout the nation have experienced a substantial increase in enrollment of students who have little or no experience in agriculture (4, 6, 7, 8). Hasslen (6), in a guest editorial on the subject of how agricultural colleges are responding to the needs of nonfarm students, reports that 60 to 70% of the nation's agricultural students lack farm or other agricultural experiences. Fry et al. (5) estimated that 50% of the incoming undergraduate students in the University of Florida College of Agriculture have no background in agriculture, and an additional 25% have limited agricultural experience. Ausubel et al. (1, 2) showed that the understanding of new academic material can be facilitated if the students has some background knowledge, such as a rural background that relates to the new material to be learned. Dale and Miller (3) reinforced the value of a rural background in academic performance of first year university students. For those students who had agricultural experience, it had been sufficient to teach the academic theory underlying the biological phenomena which they had observed. The shift in backgrounds of the majority of undergraduate agricultural students seems to mandate a reassessment and reevaluation of the educational processes used in crop science teaching.

BACKGROUND

We had perceived, from our teaching and counseling of undergraduate students in the Department of Agronomy at the University of Florida, a need for increased hands-on experiences. We have interpreted hands-on to mean student participation in all phases of the plant growth and culture in the laboratories, greenhouses, classroom sand benches, and field plots. We attempted to meet that perceived need in our courses by adding a laboratory to those courses taught by the authors which did not previously include a laboratory. Students have been encouraged to participate in the planning and decision-making, i.e., which plant species are appropriate for the study, which levels of inputs are satisfactory, and which procedures are appropriate for sampling. This participation in the planning and preparation of materials allows the student to integrate much of the information learned in disciplines such as soils, pathology, entomology, nematology, statistics, and mechanized agriculture. For example, our undergraduate plant breeding course has a unit on disease resistance in which the students discuss types of information needed and what approaches can be used to gather that information. The students record disease incidence ratings, harvest and weigh plant material, and analyze and interpret the data. In this way students must ask themselves, "Are we getting the necessary information about disease resistance and are we collecting the appropriate data to draw conclusions?" Along with the responsibility of decision-making comes the opportunity for some creative thinking.

A second example of the types of opportunities for students to acquire practical experience comes from our course in Field Plot Techniques. Students are asked to select the treatments and levels in a common experimental design, such as a factorial design, to evaluate input recommendations for a given crop as their semester project. The students must consider a variety of production factors/inputs, and from these, select a manageable number so as to acquaint them with the techniques involved in field experimentation. This exercise in evaluation of the possible limiting inputs, often learned as individual and unrelated facts, gives many students their first experience in the problem-solving approach to agricultural production. The use of dollar figures puts potential inputs into a realistic perspective. All aspects of input application, randomization,

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marking of plots, planting, selecting and recording appropriate ratings and measurements, harvesting, correcting for moisture content, and the weighing and analysis of data are done by the students, usually working together in small groups. Typically, student peers answer many of the elementary questions, liberating instructor input for more complex issues.

A third example of opportunity for hands-on experience comes from the course entitled Principles of Crop Production. Crop identification and crop management are important aspects of the course. The students plant and care for the various crops included in the course. To do this they must make certain decisions on cultural practices such as depth of planting, plant population and spatial arrangement, the amount, type, and application method of fertilizers, and any pest control measures which should be taken. The lessons learned from efforts to control pests or the failure thereof have been superior to those expected from a classroom lecture.

MATERIALS AND METHODS

Laboratory courses, in general, have received a certain amount of student criticism, causing us to reconsider the direction we had taken and the emphasis we had given to hands-on experiences in our own course formats. Do students want more hands-on experience or don't they? To measure reactions of our students as objectively as possible, we prepared a 15-item questionnaire (Table 1) requesting responses to be recorded on a scale of 1 to 5, corresponding to a range of attitudes from "strongly agree" (with the statement) to "strongly disagree." For ease of discussion, the categories of "strongly agree" and "agree" have been summed and are referred to as "agree". Similarly, "disagree" and "strongly disagree" have been combined as "disagree". Responses were recorded on a machine-scored answer sheet, submitted without identification of student. Ninety-two students in four different courses were given the questionnaire during the last regularly scheduled class period of the semester.

Our sample included students from four different classes: Principles of Crop Production, PLS 2031; Field Crop Science, AGR 4210; Plant Breeding, AGR 4321; and Field Plot Techniques, PLS 4701. Field Crop Science is offered Spring semester, and the other three courses are offered in the Fall.

Principles of Crop Production, Plant Breeding, and Field Plot Technique are elective courses. Principles of Crop Production satisfies a biology group requirement for several departments, and as such, functions as a service course. Plant Breeding serves as an elective for majors in agronomy and as a general elective for majors of other departments. Field Plot Technique is taken by undergraduate and graduate students from various departments as an elective. At the time the survey was conducted Field Crop Science was required by the Departments of Agronomy, Soils, and Agricultural Extension and Education. It has been used as an elective by students from other departments.

RESULTS AND DISCUSSION

An analysis of the student response to the questionnaire (Table 1) showed that 50% of the students in the four classes were seniors, 18% were graduate students, 16% were juniors, 8% were special students, 1% were sophomores, and 7% did not respond to the question on their classification. A possible explanation for this latter response is that there were several post-baccalaureate, nondegree candidate students in the classes who were not sophomores, juniors, seniors, or graduate students and who may not have perceived themselves as special students. On the question of backgrounds, 16% replied that they were raised on a farm, 10% responded that they had worked on a farm as hired labor, and 46% indicated that they had been involved in other agricultural work, which, from conversations with students, would suggest nursery, plant sales and similar types of limited exposure to production agriculture. Sixteen percent replied that they had no farm experience and 10% did not select any of the four options given.

Student response indicated that the students prefer courses which include laboratory sections. When asked to respond to the general statement (Item 1), "I prefer courses with lab sections to courses without lab," 70% agreed, and 10% disagreed. There was some variation in percentages among the four classes. The need of a laboratory was appreciated somewhat more by the students in Field Plot Technique, which recorded 92% agreement with the statement. Sixty percent of the students in Field Crop Science, 61% of the students in Plant Breeding, and 77% of the students in Principles of Crop Production preferred a laboratory.

Eighty-six percent of all students agreed with Item 5, "Labs were an important learning tool in the class." Three percent disagreed, and 11% replied with a neutral response.

Item 7 inquired if the students agreed that "Concepts described in class with references to labs we performed were easier to understand than concepts described without these kinds of references". Eighty-four percent agreed, 2% disagreed, and 13% expressed neutrality.

Items 4 and 13 sought information on methods perceived to be most effective in learning. When given the statement (Item 4), "I feel it is worthwhile to have labs where I have to plant, maintain, harvest, and analyze plant material, instead of having these types of tasks done for me," 76% of all students agreed, and 12% disagreed.

When asked to select an option for how an important concept should be presented (Item 13), 7% of the 92 students queried were content with lectures, 8% preferred a

Table 1. Questionnaire and student responses to survey statements about aspects of their laboratory experiences by course designation. Responses are on a scale of 1 to 5, with a 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree.

Item 1. I prefer courses with lab sections to courses without labs.

Scale	1	2	3	4	5	Total
PLS 2031	8	12	4	1	1	26
AGR 4210	10	8	9	1	2	30
AGR 4321	8	6	5	3	1	23
PLS 4701	7	5	1	0	0	13
Total	33	31	19	5	4	92
%	36	34	21	5	4	†
#‡	70%			10%		

(continued)

Table 1. Continued.

Item 2. Associated issues (apart from the specific lab objectives), such as weed, insect and disease incidence, and how each is treated, are positive features of field laboratories.

Scale	1	2	3	4	5	Total
PLS 2031	14	9	2	1	0	26
AGR 4210	15	14	1	0	0	30
AGR 4321	9	14	0	0	0	23
PLS 4701	8	5	0	0	0	13
Total	46	42	3	1	0	92
%	50	46	3	1	0	
#	96%			1%		

Item 3. I prefer a lab where I can collect data from the field to one where the data are already furnished.

Scale	1	2	3	4	5	Total
PLS 2031	12	6	8	0	0	26
AGR 4210	15	9	2	3	1	30
AGR 4321	6	9	7	1	0	23
PLS 4701	6	6	1	0	0	13
Total	39	30	18	4	1	92
%	42	33	20	4	1	
#	75%			5%		

Item 4. I feel it is worthwhile to have labs where I have to plant, maintain harvest, and analyze plant material, instead of having these types of tasks done for me.

Scale	1	2	3	4	5	Total
PLS 2031	15	6	3	2	0	26
AGR 4210	19	6	2	2	1	30
AGR 4321	4	8	5	6	0	23
PLS 4701	8	4	1	0	0	13
Total	46	24	11	10	1	92
%	50	26	12	11	1	
#	76%			12%		

Item 5. Labs were an important learning tool in this class.

Scale	1	2	3	4	5	Total
PLS 2031	11	9	4	2	0	26
AGR 4210	16	10	3	1	0	30
AGR 4321	7	15	1	0	0	23
PLS 4701	7	4	2	0	0	13
Total	41	38	10	3	0	92
%	45	41	11	3	0	
#	86%			3%		

Item 6. I would rather participate in a lab where the treatments/activities have known or expected results than in one in which the results have not been previously obtained.

Scale	1	2	3	4	5	Total
PLS 2031	2	5	7	8	4	26
AGR 4210	6	9	8	2	5	30
AGR 4321	3	3	11	6	0	23
PLS 4701	2	2	3	4	2	13
Total	13	19	29	20	11	92
%	14	21	32	22	12	
#	35%			34%		

Item 7. Concepts described in class with references to labs we performed were easier to understand than concepts described without these kinds of references.

Scale	1	2	3	4	5	Total
PLS 2031	11	10	3	1	1	26
AGR 4210	13	10	6	0	0	30
AGR 4321	12	9	2	0	0	23
PLS 4701	3	9	1	0	0	13
Total	39	38	12	1	1	92
%	42	41	13	1	1	
#	83%			2%		

Item 8. Time spent in labs could be better spent in the classroom.

Scale	1	2	3	4	5	Total
PLS 2031	0	3	2	16	5	26
AGR 4210	0	0	4	11	15	30
AGR 4321	0	0	5	12	6	23
PLS 4701	0	0	0	8	5	13
Total	0	3	11	47	31	92
%	0	3	12	51	34	
#	3%			85%		

(continued)

Table 1. Continued.

Item 9. I think there is too much written work associated with field labs.

Scale	1	2	3	4	5	Total
PLS 2031	1	1	4	16	4	26
AGR 4210	2	1	12	9	6	30
AGR 4321	0	4	9	6	4	23
PLS 4701	0	1	2	8	2	13
Total	3	7	27	39	16	92
%	3	8	29	42	17	
#	11%			59%		

Item 10. I would like more hands-on experience in the lab.

Scale	1	2	3	4	5	Total
PLS 2031	8	13	5	0	0	26
AGR 4210	14	11	5	0	0	30
AGR 4321	2	10	9	2	0	23
PLS 4701	3	7	2	1	0	13
Total	27	41	21	3	0	92
%	29	43	23	3	0	
#	73%			3%		

Item 11. I believe that having had some field exposure gives me a better chance of getting the position I want upon graduation.

Scale	1	2	3	4	5	Total
PLS 2031	8	9	9	0	0	26
AGR 4210	10	13	6	1	0	30
AGR 4321	6	9	5	3	0	23
PLS 4701	7	6	0	0	0	13
Total	31	37	20	4	0	92
%	34	40	22	4	0	
#	74%			4%		

Item 12. I believe that students should be involved in planning the labs.

Scale	1	2	3	4	5	Total
PLS 2031	5	9	7	4	1	26
AGR 4210	9	6	8	6	1	30
AGR 4321	1	7	6	8	1	23
PLS 4701	4	5	3	1	0	13
Total	19	27	24	19	3	92
%	21	29	26	21	3	
#	50%			24%		

Item 13. If an important concept were being presented in a course, and you had the option, which of the following would you prefer? (Choose one of the following: 1 = Explanation in lecture, 2 = Demonstration in lecture, 3 = Demonstration in lab with plants in the field, or 4 = Experiment in the field where you had to do the work.)

Choice	1	2	3	4	No choice	Total
PLS 2031	2	5	10	8	1	26
AGR 4210	1	0	16	12	1	30
AGR 4321	3	2	12	6		23
PLS 4701	0	0	5	8		13
Total	6	7	43	34	2	92
%	7	8	47	37	2	

Item 14. Your classification at UF§ is (Choose one: 1 = sophomore, 2 = junior, 3 = senior, 4 = graduate student, or 5 = special student):

Choice	1	2	3	4	5	No choice	Total
PLS 2031	0	11	11	0	2	2	26
AGR 4210	1	2	16	4	3	4	30
AGR 4321	0	1	14	6	2		23
PLS 4701	0	1	5	7			13
Total	1	15	46	17	7	6	92
%	1	16	50	18	8	7	

Item 15. Your farm experience is (Choose one: 1 = raised on farm, 2 = worked on a farm as hired labor, 3 = other agricultural work, or 4 = none).

Choice	1	2	3	4	No choice	Total
PLS 2031	7	1	8	7	3	26
AGR 4210	4	2	14	6	4	30
AGR 4321	3	6	11	3		23
PLS 4701	1	0	9	1	2	13
Total	15	9	42	17	9	92
%	16	10	46	18	10	

† Percentages may not add to 100% due to rounding.
‡ Combined percentage at the low and high end of the scale.
§ University of Florida, Gainesville.

demonstration in lecture, 47% elected a "demonstration in lab with plants in the field", and 37% wanted to do "experiment in the field where you had to do the work."

When the statement concerning laboratory value was put in negative terms, i.e., "time spent in labs could be better spent in the classroom" (Item 8), only 3% of the 92 students agreed, all 3 of them being in the service course, Principles of Crop Production. It should be noted that the students in this course were expected to go to the field plots from 1220 to 1415 h in the Florida heat in August and September, a possible factor in the results. Future laboratory scheduling will take this aspect into account.

Students expressed a desire to collect and record their own data. Seventy-five percent of all students agreed with the statement (Item 3), "I prefer a lab where I collect data from the field to one where the data are already furnished."

When the students were asked if they preferred to do original research (Item 6), the responses were divided, with 33% preferring to do original research, 35% content to repeat known research and 32% not indicating a preference. Interestingly, 46% of the students in Principles of Crop Production wanted to do original research, compared to 23% for the students in the more advanced Field Crop Science class.

Item 12, "I believe that students should be involved in planning the labs", received a positive response from 50% of the 92 students. Twenty-four percent disagreed, and 26% were neutral. The individual class with the highest percentage in favor of student planning was Field Plot Technique (69%), a course that offers considerable opportunity for student planning of a research project and has a relatively high graduate student enrollment.

Although written assignments associated with laboratory and field work varied from little, in Principles of Crop Production, to extensive, in Field Plot Technique, students appeared to accept what was requested of them. In response to the statement (Item 9), "I think there is too much written work associated with field labs", only 11% agreed with the statement, and 60% disagreed.

Whenever one deals with biological organisms, there is the possibility of unanticipated results. When asked to respond to the statement (Item 2), "Associated issues (apart from the specific lab objectives) such as weed, insect, and disease incidence, and how each is treated, are positive features of field laboratories", an overwhelming 96% of the respondents agreed. Only one student disagreed. This may be one of the better indications of student interest in field/plot exposure. From the response to this item, instructors can justify spending time on the spontaneous issues concerning plant growth and culture which arise during the course of events in a planned laboratory.

From the above responses, it is apparent that the majority of students surveyed favored hands-on laboratory and field experiences. This information leads to a corrollary: if this amount of hands-on experience is good, would more hands-on experience be perceived as better by the student? The statement, "I would like more hands-on experience in the lab" (Item 10) received a 73% agreement response. Only 3% disagreed and 23% marked a neutral response. Clearly, the majority of the students did not believe that they had reached the saturation point with their hands-on experiences.

The final issue was whether the students feel better prepared for the job market as a result of the hands-on experiences they have had in their course work. The statement, "I believe that having had some field exposure gives me a better chance of getting the position I want upon graduation" (Item 11), received 74% support from the students. Only 4% thought that the field experience would not help them get the position they wanted.

CONCLUSION

Ninety-two students in four plant science classes were surveyed by questionnaire regarding hands-on type laboratory exercises, including field laboratories. Three of four students favored courses with laboratories over those without, desired doing their own cultural management work and collecting their own data, and agreed with the statements that labs are important learning tools, that concepts are easier to understand when performed in laboratories, and that field exposure will help them in the job market. One-half of the students expressed the desire to participate in the planning of their laboratory experiences and one third of the students were in favor of doing original research.

Student support for their own involvement in the laboratory activities is encouraging to instructors who have financial constraints on resources needed to maintain nurseries, field plot experiments and demonstrations. Student participation in the preparation and care of the hands-on laboratory projects is one method of simultaneously aiding teaching within budget constraints, while enriching the learning experience, especially for those who do not have previous farm background or agricultural experience.

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