including how to accomodate for regional differences, how much emphasis should be placed on academic versus nonacademic skills, who should administer the test.

Obviously legislators and administrators have been willing to allow program quality in agricultural programs to be determined at the local level. However, with declining enrollment trends it is questionable whether or not this will continue. Numerous professions, such as nursing, dentistry, general medicine, veterinary medicine, engineering, K-12 public schools, and the legal profession do not allow individuals to practice their profession without passing a state, regional, or national test. In other words, quality is determined by selected representatives of the profession, not by local institutions. Is agriculture so different? Maybe we should give serious consideration to developing local, regional, and/or national tests so that individual institutions might have a standard test by which to compare their students' performance with some regional or national norm. The National Association of Colleges and Teachers of Agriculture may be the ideal organization to provide the leadership in this task.

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CASE STUDY

Are Introductory Courses Effective?

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Introduction

There is often a wide range of interests and backgrounds among students enrolled in any introductory course (7). This diversity led us to ask: Can a single introductory course satisfy the differing needs of these students? This paper describes the study of an introductory horticulture course in which both horticulture majors and non-majors are enrolled. The study evaluated the effects of the course on students' appreciation of plants, their thought patterns, and their knowledge of plants before and after taking the course.

The Course and Its Objectives

Horticulture 100 is a one semester introductory horticulture course with no formal laboratory. It is offered twice a year at New Mexico State University. Lectures, demonstrations, and class materials have been developed to emphasize concepts of plant growth, development, and productivity. Factors which limit growth (light, temperature, water, and nutrients) are stressed, and relationships between these concepts and specific horticultural practices are examined. Many facts are presented during lectures, but students are not directly responsible for learning them.

Because there is no laboratory, living plants are frequently used for demonstrations. Students are encouraged to examine these plants closely, and to think about what they observe. Projects which are distributed regularly allow students to grow plants at home and encourage them to carefully and repeatedly study the plants. Thus, the students become acquainted with the dynamic aspects of plant growth and are encouraged to become actively involved with plants and with the learning process.

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Evaluation Methods

The effects of the course on students' knowledge and attitudes were evaluated with two unannounced questionnaires administered at the beginning and at the end of one fall-semester and one spring-semester class. Each sample consisted of those who voluntarily completed these questionnaires on both testing dates.

The first questionnaire, which was prepared by the authors, measured plant appreciation, knowledge, and contact. The plant appreciation scale measured students' attitudes towards plants by asking them to rate such statements as "I like plants because they spark a wonder about the future." The horticultural knowledge scales tested the students' familiarity with concepts and facts which were presented in class. The final part of this questionnaire measured the extent of students' previous experiences with plants. Students with only occasional contact with plants were placed in the low plant-contact subgroup, while those with more extensive contact (such as those who were raised on farms or who took vocational horticulture in high school) were placed in the high plant-contact subgroup.

The second questionnaire used was the nationally standardized personality inventory: Cattell's 16 Personality Factor Questionnaire (the 16 PF test), Form A, from the Institute for Personality and Ability Testing in Champaign, Illinois. This multiple choice question-

Table 1. Students' mean scores on the plant appreciation scale before and after enrolling in the introductory horticulture class. Scale ranges from 20, indicating an extreme dislike of plants, to 80, representing an indiscriminate liking of plants.

	Fall Class				Spring Class			
	DF	Before	After	Change	DF	Before	After	Change
Total class	45	58	67	9**	57	64[z]	63[z]	-1
Horticulture majors	15	60	69	9**	9	65	62[y]	-3
Other majors	29	57	66	9**	47	64[z]	63	-1
A or B in class	27	60	68	8**	35	65[z]	62[y]	-3*
C, D, or F in class	17	56	68	12**	21	63[y]	65	2
Low plant-contact	24	58	66	8**	38	64[y]	64	0
High plant-contact	20	58	69	11**	18	65[z]	62[z]	-3*

* ** Significant at 5% or 1% level, respectively.
y, z Spring score differed from Fall, significant at 5% or 1%, respectively.

Table 2. Students' mean scores on the horticultural concepts scale before and after enrolling in the introductory horticulture class. Scale ranges from 0 to 10, with a high score representing high knowledge.

	Fall Class				Spring Class			
	DF	Before	After	Change	DF	Before	After	Change
Total class	45	5.7	6.9	1.2**	57	4.8[z]	6.6	1.8**
Horticulture majors	15	5.9	7.3	1.4**	9	4.9	7.7	2.8**
Other majors	29	5.6	6.7	1.1**	47	4.8[y]	6.4	1.6**
A or B in class	27	6.0	7.5	1.5**	35	5.0[z]	7.5	2.5**
C, D, or F in class	17	5.3	6.0	0.7	21	4.4	5.1	0.7
Low plant-contact	24	5.7	6.6	0.9**	38	4.7[y]	6.4	1.7**
High plant-contact	20	5.7	7.2	1.5**	18	4.9	6.9	2.0**

* ** Significant at 5% or 1% level, respectively.
y, z Spring score differed from Fall, significant at 5% or 1%, respectively.

Table 3. Students' mean scores on the horticulture facts scale before and after enrolling in the introductory horticulture class. Scale ranges from 0 to 10, with a high score representing high knowledge.

	Fall class				Spring class			
	DF	Before	After	Change	DF	Before	After	Change
Total class	45	5.4	7.5	2.1**	57	5.6	7.4	1.8**
Horticulture majors	15	5.7	8.2	2.5**	9	5.9	8.4	2.5**
Other majors	29	5.2	7.1	1.9**	47	5.6	7.2	1.6**
A or B in class	27	5.9	8.3	2.4**	35	5.9	7.9	2.0**
C, D, or F in class	17	4.6	6.2	1.6**	21	5.3	6.6	1.3**
Low plant-contact	24	5.2	7.2	2.0**	38	5.2	7.1	1.9**
High plant-contact	20	5.7	7.9	2.2**	18	6.6[y]	8.0	1.4**

* ** Significant at 5% or 1% level, respectively.
y Spring score differed from Fall, significant at 5% level.

naire provides information about sixteen different personality factors, such as shyness, shrewdness, and intelligence. For this study, raw scores on this inventory were converted to sten scores, based on norms for college students (3).

Pretest and posttest scores were compared using paired t-tests. Non-paired t-tests were used to compare scores of students in the fall-semester class to those in the spring-semester class. Three subgroups were also analyzed: major (horticulture vs. other), class grade (A or B vs. C, D, or F), and plant-contact prior to the class (low vs. high).

Results and Discussion

Appreciation for plants. Students in the fall semester showed a significant increase in their scores on the plant appreciation scale (Table 1). All subgroups of the fall semester also increased. It seems the course was important in improving their attitudes towards plants.

While students in the spring semester began the class with significantly higher plant appreciation scores than did those in the fall, they changed little in their appreciation for plants during the class (Table 1). Research has shown that the more narrow students' objectives are, the less open they are to change (5). Many students in the spring took introductory horticulture for very specific reasons. Perhaps their specific expectations for the course caused them to be less engaged by the conceptual teaching method used in the course. It is also possible that the plant appreciation scale did not discriminate well at the upper end: students enrolled in the spring semester had relatively high scores when they enrolled.

Among the subgroups analyzed, those earning a C, D, or F had the largest increases in their appreciation for plants both semesters (Table 1). Such results were unexpected, because education studies have shown that reduced interest usually follows failure; exceptions occur when failure is accompanied by expectations for future success (4). Perhaps these low achievers maintained expectations for subsequent successes with plants, and thus developed a more positive attitude towards plants.

Conceptual and factual knowledge. Students in both the fall and spring semesters showed highly significant gains in their knowledge of horticultural concepts after taking the course (Table 2). While those in the spring semester entered knowing significantly fewer concepts than students in the fall, the levels of conceptual knowledge did not differ significantly after completing the course. Thus, an important course objective was achieved: to help students develop a conceptual framework for the study of horticulture.

Factual knowledge scores also increased significantly for students in both classes (Table 3), yet facts were not emphasized and there were few grade incen-

tives for learning them. Similar findings are common in education literature, and can be explained using Bloom's Taxonomy (1) which ranks cognitive educational behaviors from simple to complex as follows: knowledge, comprehension, application, analysis, synthesis, and evaluation. The factual questions in the authors' questionnaire required knowledge behaviors, while the conceptual questions required knowledge, comprehension, and application behaviors. By concentrating our efforts on teaching concepts (more complex behaviors), we apparently helped students learn facts (simpler behaviors) in the process.

Students in the high plant-contact subgroup scored higher and had larger gains on the horticultural concept scale than did students in the low plant-contact subgroup (Table 2). This result is consistent with learning theory which shows that generalizations or concepts which are isolated from the specific situations they cover are difficult to learn and hard to retain (1, 6). It is possible that increasing students' experiences with plants during the course would enhance their learning of and retention of important horticultural concepts.

Horticulture majors had higher scores on the horticultural concepts and facts scales than did other majors in both semesters (Tables 2, 3). The high motivation of horticulture majors, coupled with their previous experiences with plants, probably enhanced their understanding of the class material.

Personality. Scores on some factors of the 16PF test are expected to vary due to normal fluctuations and maturation (2,3). Only the results for Factor B, which classifies a person's intelligence and thinking processes, appeared to be related to the effects of the introductory horticulture course (Table 4). Low scores on Factor B are associated with thinking which is concrete and involves the memorization of facts, while high scores are associated with thinking which is abstractly or conceptually oriented (2). Scores varying around 5 and 6 are considered average for college students (2).

The scores for students enrolled in this course generally fell on the low side of average for college students, and there were no significant changes for either class as a whole (Table 4). Among subgroups, there were significant trends towards more abstract thinking in horticulture majors both semesters. Since the course emphasized concepts about plants, it is probable that this course contributed to the change. Educational psychologists have noted that increased conceptual learning in one specific area can result in increased conceptual learning in general (6). Many of the horticulture majors in these classes studied vocational horticulture in high school. This previous exposure to plants probably established a mental framework which facilitated the organization and learning of additional abstract ideas (1).

Conclusions

These results indicate that a single introductory course can be effective in reaching many different types of students. Within a framework which emphasized concepts while presenting supporting facts and which encouraged active student involvement both in the learning process and with plants, horticulture majors, non-majors, and lower academic achievers were all benefited.

By concentrating time and energy on teaching concepts (the more complex educational behaviors), facts were also learned in the process. This method is especially effective with students having an established factual base; the ease with which these students are able to think conceptually in one area may encourage them to think conceptually in other areas. The challenge is to provide other students with an opportunity to build the factual base which will enhance conceptual learning. If laboratories are not possible, other means of actively involving students with plants and with the learning process should be sought.

Encouraging students to grow plants and to become aware of the possibilities for using plants probably contributed to the improved attitudes towards plants among students who earned low grades in the course. If teachers take advantage of opportunities to instill expectations for future success in all students, then non-majors and low-achievers, as well as agriculture majors, may become ambassadors for the profession.

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Table 4. Students' mean scores on Factor B (Thinking Mode) of the 16PF Test before and after enrolling in the introductory horticulture class. Scale ranges from 1 (concrete-thinking, less intelligent) to 10 (abstract thinking, more intelligent), with scores of 5 and 6 representing average.

	Fall class				Spring class			
	DF	Before	After	Change	DF	Before	After	Change
Total class	55	4.39	4.39	0.0	43	4.37	4.65	0.28
Horticulture majors	18	4.00	5.05	1.05*	8	5.44[x]	6.44[y]	1.00#
Other majors	36	4.59	4.05	-0.54#	33	4.09	4.18	0.09
A or B in class	29	5.00	5.03	0.03	26	4.70	5.30	0.60
C, D, or F in class	25	3.69	3.65	-0.04	15	3.81	3.56	-0.25
Low plant-contact	27	4.28	4.03	-0.25	26	3.93	4.30	0.37
High plant-contact	27	4.50	4.75	0.25	15	5.12	5.25	0.13

#, * Significant at 10% or 5% level, respectively.
x, y Spring score differed from Fall, significant at 10% or 5%, respectively.

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Plant Appreciation, Knowledge and Contact Questionnaire

PART I: DIRECTIONS:

Why do you like plants? Below are various possible answers to the question, why do you like plants. Read each statement carefully. Decide how you feel about the statement. Darken the circle which corresponds to the most appropriate choice. Respond to all statements.

I LIKE PLANTS BECAUSE	Strongly Agree	(Scale) Agree	Disagree	Strongly Disagree

1. plants provide food.
2. plants are natural.
3. plants grow and develop.
4. plants are unresponsive to help.
5. plants can be shared.
6. plants give an emotional lift.
7. plants provide a source of income.
8. plants are undependable friends.
9. I enjoy green in my home.
10. I enjoy giving something of myself away.
11. plants give a feeling of responsibility.
12. there is something missing without them.
13. they help cheer me up.
14. they don't talk back.
15. I can relax in their company.
16. plants stimulate my senses (i.e. smell)
17. plants do not challenge me.
18. plants spark a wonder about the future.
19. working with plants gets me outdoors.
20. I can be alone with plants.

Do you like plants? _____ Yes _____ No

PART II & III: DIRECTIONS

Read each question carefully. Choose the best answer. Place an "X" in the blank to the left of the best answer.

21. When transpiration exceeds the water absorption in a plant, the result is:
    _____1. wilting.
    _____2. growth.
    _____3. elongation.
22. Optimal plant growth occurs when the rate of photosynthesis _____ the rate of respiration.
    _____1. is less than.
    _____2. equals.
    _____3. is more than.
23. Greenhouse peas which produce long, vigorous vines with few flowers were probably grown:
    _____1. at temperatures below the optimum, so carbohydrate accumulation occurs.
    _____2. with abundant nutrients, causing carbohydrate utilization.
    _____3. with low water, thus limiting the optimal plant growth.

39. T-budding is a method used in:
    _____1. flower crop production.
    _____2. grafting.
    _____3. sexual propagation.
40. General yellowing of a plant leaf is termed:
    _____1. chlorosis.
    _____2. Paleontosis.
    _____3. wilted.

PART IV: DIRECTIONS:

Read each question carefully. Answer as correctly as you can.

1. What horticulture classes are you taking this semester?

2. What horticulture classes have you previously taken (including high school)?

3. How many houseplants are in your home environment?
    _____1
    _____2-4
    _____5-10
    _____11 or more
4. Do you care for these houseplants?
    _____No.
    _____Yes, some of them.
    _____Yes, all of them.
5. Is the environment around your home landscaped?
    _____Yes.
    _____No
6. Did you landscape it?
    _____No.
    _____Yes, part of it.
    _____Yes, all of it.
7. Have you been employed working with plants in a commercial business?
    _____No.
    _____Yes. How long?_____
    TYPE
    _____Nursery
    _____Florist Shop
    _____Other (specify)_____
    _____Greenhouse
    _____Farm or ranch
8. How often do you work with plants?
    _____Never.
    _____Less than 10 hours each year.
    _____More than 10 hours each month.
    _____More than 10 hours each year.
    _____More than 10 hours each week.
9. How often do you visit gardens or parks (in the community or at a friend's) to enjoy the plants?
    _____Never.
    _____Less than once a year.
    _____1-3 times a year.
    _____4-12 times a year.
    _____13 or more times a year.