Cox, D. E. and E. Zamudio.1993. Student learning styles and effective teaching. The Agricultural Education Magazine 66(5): 5-6, 22.

Dunn, R. S. and K.J. Dunn.1979. Learning styles/teaching styles: should they...can they...be matched? Educa tional Leadership 36: 238-244.

Entwistle, N. J. and P. Ramsden.1983. Understanding student learning. New York: Nichols Publishing Company.

Gregorc, A. F.1979. Learning/teaching styles: potent forces behind them. Educational Leadership 36: 234-237.

Keefe, J. W. and J.S. Monk.1986. Learning style profile. Reston, VA: National Association of Secondary School Principals.

Raven, M. R. and V. Shelhamer.1993. The relationship between students' ability to demonstrate the problem solving approach to teaching in a methods class and their learning styles. Proceedings of the Twentieth Annual National Agricultural Education Research Meeting, 89-97, Nashville, TN.

Whittington, M. S. and M. Raven.1995. A comparison of learning styles, teaching styles and personality types of student teachers. Journal of Agricultural Education 36(4): 10-17.

Witkin, H. A., P.K. Oltman, E. Raskin, and S.A. Karp, S.A. 1971. Group Embedded Figures Test manual. Consulting Psychologist Press, Inc.: Palo Alto, CA.

Revitalizing an Introductory Laboratory Course in Environmental Science --Taking Student Opinion Into Account

James J. Riley[1], Environmental Research Laboratory, Soil, Water and Environmental Science Department, University of Arizona, Tucson, AZ 85706

"I actually have learned a lot, but have not found any of it relevant to my personal life." Student comment about the introductory environmental laboratory course, Spring 1996

Abstract

Survey results from students in four sections of an introductory environmental science laboratory indicated that 1) the lab topics were acceptable but did not develop practical problem-solving skills applicable to the real world, 2) labs failed to develop a spirit of inquiry, 3) an informal professional relationship with the instructor was achieved, 4) the addition of teaching assistants would be desirable, and 5) pre-lab worksheets improved understanding of lab exercises. Based on these results, lab exercises are being revised to make them more inquiry-based and better related to students lives. A program to use undergraduate teaching aides, preceptors, is planned for the Fall semester.

[1] Senior Research Assistant

Introduction

I just completed my second semester of teaching Introduction to Environmental Science Laboratory: Land, Water and Air, at the University of Arizona (UA), which has been offered for 6 years by the Soil, Water and Environmental Science (SWES) Department. It is a one unit general education laboratory science course primarily for non-majors in environmental science. Student enrollment is composed of undergraduates, mostly freshmen and sophomores. Four sections of the laboratory are offered weekly, each with an enrollment of 15-25 students. SWES faculty teach most of the lab sections. Occasionally, one or more of the labs are taught by departmental graduate teaching assistants.

The course consists of 12 laboratory exercises, 1 group discussion, and 1 field trip. The laboratory exercises are equally divided between general topics (scientific method, ecology, and remote sensing), land related subjects (soil physical & chemical properties, sorption of waste products, and microbiology/bioremediation), water characteristics (water quality and ground water movement), and air properties (greenhouse effect and effects of air pollution on the biosphere). A lecture course with a similar name is offered separately. The majority of the students in the laboratory also are enrolled in the lecture.

Most students I taught completed the course with satisfactory grades, but I sensed a certain degree of apathy among them. This is unfortunate because a few students in the course are apparently considering a science curriculum. Tobias (1990) argues that the loss of borderline students to other disciplines is a major reason for the low number of scientists being turned out by universities. She concludes they need more encouragement to consider a career in science. For other students the introduction to environmental science course may be their only college science laboratory course and, therefore, their only contact with science, scientists and the conducting of science, termed "sciencing" (Anderson, 1976). The course aims to make these students more knowledgeable citizens by conveying some essential environmental concepts. The companion lecture course is scheduled to be included in the UA core curriculum which is likely to result in a dramatic increase in laboratory enrollment. All of these factors contributed to the impetus to revitalize the laboratory course.

Two popular UA introductory laboratory programs in Chemistry and Geosciences encourage undergraduate students to conduct independent laboratory studies (Brown, 1996; Kresan, 1996). They do not follow the routine of traditional laboratories, like the environmental science lab, in which students are presented with highly structured exercises where they complete a few activities, fill in blank data sheets or graphs, and then reply to short-answer questions. I concluded that our lab class would be better if the traditional laboratory model were abandoned in favor of alternative laboratory teaching approaches. Exercises would be included that challenge students to think and to capture their imagination, hopefully motivating them to develop a sense of critical awareness and a better understanding of science, sciencing and scientists (Anderson, 1976; Riley, 1996). Prior to working with my colleagues to revitalize our lab, I thought it would be wise to seek input from students currently enrolled in the lab.

Methodology

During the Spring semester of 1996, the second semester I taught the introduction to environmental science laboratory course, I prepared and distributed a questionnaire to garner student opinion about the course. The responses to an earlier, shorter, questionnaire, given to only one section of the laboratory, demonstrated that some students could be counted on to provide insightful and useful comments (Riley, 1996). The longer questionnaire was distributed about two-thirds through the Spring semester of 1996 to all four lab sections. Students were advised that anonymous responses were desired. Results of questions requiring simple answers were tabulated. The essence of responses to essay questions were noted. Where the same ideas were expressed more than once, the frequency was recorded. A total of 56 responses were received out of 85 students enrolled in the course. The results are summarized in the following sections.

Results

Course Expectations

Students were asked why they took the lab and what their expectations were. The most frequent response was that they took the course because a lab science was required for graduation. Many said they thought an environmental science lab would be easier than one in chemistry or physics. Those who mentioned content indicated they took the course to learn more about the environment, to supplement lecture material, or to learn about soil and water. Several respondents noted they were looking forward to a hands-on learning opportunity.

Laboratory Goals

Students were given a list of goals for labs, based on previous studies (Anderson, 1976; Brown, 1996; Columbia University Teachers College, 1938; Flood and Moll, 1990; Kresan, 1996; Riley, 1996; University of London, 1969) and asked whether the environmental science laboratory met or failed to meet the listed goals. The highest-rated goal achieved was the attainment of an informal interaction with the instructor (91.1%) (Table 1). The lowest was developing problem-solving skills applicable to the real world (57.1%), with developing a spirit of inquiry the next lowest (63.0%).

Perceived Positive and Negative Aspects

When asked about the positive and negative aspects of the lab, students rated the instructor's willingness to help, the opportunity to learn about the environment, and the chance to have a hands-on learning experience equally high (Table 2). The same topics were also rated as goals achieved by more than 80% of the respondents (Table 1). The majority of the positive comments were related to the content of the lab, while the negative comments mostly addressed the dynamic of the laboratory itself (Table 2). In a separate question, 71.4% of the students indicated that pre-lab worksheets were helpful to their understanding of a given lab exercise.

Table 1. Student evaluation of attainment of indicated laboratory goals. (Totals do not always add to 100% as some students were undecided.)

Goals	Goals achieved? Yes	No
Informal interaction with instructor	91.1	8.9
Improving understanding of scientific methods	89.3	10.7
Collecting, managing and understanding data	87.5	8.9
Learning observational or hands-on skills	84.2	14.0
Becoming critically aware of surrounding environment	81.8	16.4
Increasing awareness of science in your daily lives	76.8	21.4
Illustrating lecture material	76.4	23.6
Experiencing nurturing professional attitudes	72.7	27.3
Developing spirit of inquiry	63.0	35.2
Developing problem-solving skills for real world	57.1	41.1

Table 2. Positive and negative course perceptions (listed in approximate order of importance).

Positive points	Negative points
teachers are interesting and willing to help	labs are time consuming
learning about the environment	labs are too hard
hands-on learning	tests are too hard
relation of topics to real life	too much work for 1 unit
effect of pollutants on the environment	too many exams
activities are fun	early morning laboratories
working with others	field trip to wastewater treatment facility
field trips	labs are boring
illustration of material covered in lectures	students coddled too much
more interesting than anticipated	lab groups are too large
learning scientific methods and terminology	labs do not relate enough to the real world
seeing bacteria in Lab #9	hydrologic model too simplistic
finding out about water quality of different samples	written lab introductions too long

Table 3. Course revisions recommended by students to reduce the perceived negative aspects (listed in approximate order of priority).

Topics related to lab content or dynamic	Topics related to evaluation tools
see things covered in the lab in real life	prepare test study guides
add assistants to help out lab instructors	increase units
explain procedures better	eliminate or schedule fewer tests
help students understand instruments	make labs shorter
more field trips	make exams more specific
don't visit wastewater treatment plant	make labs count more and tests less
explain concepts, but don't answer questions (for students)	meet more than once per week
	give weekly tests
have smaller lab groups	make lab questions easier
fewer x-y graphs	make labs more difficult
make labs more challenging	make tests easier
switch members of working groups	have shorter labs on exam days
have fewer labs and more discussions	require written lab reports

The aspects of the lab considered most negative by respondents were the length and difficulty of the lab exercises. and the number and difficulty of the exams (Table 2). The complaint, voiced throughout the questionnaire responses, was that the labs did not sufficiently relate to the real world.

Recommendations on how to address negative aspects of the course were numerous (Table 3). A number of proposed remedies related to exams. Many conflicted, which is not surprising given the diverse student population. However, interest in seeing labs relate more to real-life situations received high priority, as was evidenced in responses in other portions of the questionnaire.

Evaluation of Course Content and Suggested Actions

Students were not discriminating when asked to evaluate individually the nine labs they had already completed. Lab exercises rated highly by some students were recommended for revision or elimination by others. Students suggested that there be more samples of things to see, like the bacteria observed in one lab, and that topics such as marine life, wildlife, composting, re-cycling, global warming and the effect of cigarette smoke be added to the lab topics. Some of these topics are touched on in the introductory lecture course, but receive little attention in the lab. These responses give an indication of what students mean when they say they want topics related more to their daily lives.

Students endorsed the idea of making the labs less structured in order to give them more chance to experience the thrill of discovery by 2:1. When asked if they wanted the labs more inquiry-oriented, they opposed it by almost the same margin. Students were about equally split on whether they would like to see more diversity in the labs. These mixed signals are similar to those received on the individual lab evaluations and reflect the diversity of student opinion. Several students took the time to write more extensive comments, some were written with tongue-in cheek, but others were quite insightful.

The question receiving the highest affirmative vote was the one asking whether there should be more field trips. The response was "Yes" by 93.2% of students. Students had numerous constructive suggestions as to where field trips might be scheduled in the region. When asked to indicate topics which should be given more attention in the course, students ranked the following most highly: 1) relation of exercises to the real world, 2) examination of the campus environment and 3) preparing students to be sensitive to the environment.

Weight of Exams Relative to Lab Reports in Grading

By nearly a two-to-one margin students indicated laboratory reports should count more than the current 60% of the potential points that can be earned in the course. Several suggested a 70%-30% split between lab reports and exams, respectively. Many mentioned that they would prefer more short, weekly exams covering only one lab to the four exams per semester given now.

Provide calculators?

At present, students are asked to purchase their own calculators but many do not. Calculators are used mostly to facilitate calculating averages and standard deviations. Some students bring sophisticated calculators to the lab, for which the instructions have been invariably lost. The net result is that a considerable amount of lab time is spent trying to teach students to use a variety of calculators and, even with this, students lose points on almost every lab and exam because they cannot perform the required calculations. Students were asked whether a standard calculator should be provided with the course, even if it meant an increase in lab fees. Students were split on this subject. Some said they already had calculators and did not want to pay for another. Others heartily endorsed the idea.

Summary and Conclusions

Course evaluation and revisions

The questionnaire responses clearly indicate a need to make the labs more interesting and relevant. The messages and suggested actions from students fall into three categories: lab dynamics, content and instruction.

Lab dynamics • A more consistent use of the pre-lab briefing sheets may help students to understand a lab and how it relates to "real-life". The exams are going to be replaced by weekly quizzes on the previous week's lab and their overall weight reduced from 40% to 30% of the course grade. Extra-credit points will be given to encourage students to take a more pro-active role in the lab. Points will be given, for example, for bringing in articles on the environment or samples which students would like to test and for conducting experiments on their own.

The busywork of the labs is going to be reduced to allow more time for discussion and student participation. The labs, as presently structured. often require many observations or measurements, thus cutting down on time for both students and instructors to reflect on the meaning of the activities. Allowing more opportunity for students to understand the subject matter with less "spoon feeding" of material is intended to address several of the negative aspects mentioned by students.

The addition of a second field trip to the lab would necessitate eliminating one lab exercise. Students haven't given much guidance on which lab to cut. This has been discussed among the organizing faculty and staff but has not yet been resolved. Mini-field trips around the campus may be included in one or more of the labs to emphasize the relationship of the exercises to "real-life" conditions.

Lab content • The lab manual is being re-written. New topics suggested by students are being considered for inclusion. Some exercises will require students to to develop and test their own hypotheses, preferably on topics related to campus and/or campus life. Manuals for introductory courses in Geosciences (Kresan, 1996) and Chemistry (Brown, 1996) plus the lab exercises given in the Biology Teacher's Handbook (Schwab, 1963), are being used as models on which to base the new environmental science lab manual.

Previous studies (University of London, 1969) have shown that students must be convinced that any "new approach" to teaching be equal to or better than the "old approach." The mixed signals received from students on reorganization of the lab are indicative of this phenomenon. As the manual is changed, students must be given assurance that their interests will be served equally as well, if not better, by the new format. Students will be polled again for their opinions during the 1996/97 school year to see if the re-written labs are better received. The concepts or principles covered in the labs must be related to "real- life" conditions, as perceived by students. .

We are going to provide a simple calculator with the lab manual. Accordingly the course fee will be increased about $10. Instructions will be given in the first lab on how to calculate the mean and standard deviation plus other calculations needed in the labs. Hopefully, this will improve student skills in making these calculations and reduce the time for repetitive explanations on how to use calculators.

Attainment of skills on particular instruments are being shifted to the first labs so students will be capable of using a wide variety of instruments early in the course and able to use them in later exercises, as required. An effort will be made to keep key equipment at stations in the lab throughout the semester, so they are available to students at all times. We will attempt to acquire a simple dissecting microscope that will be permanently located in the lab so students and instructors alike can make observations of interest.

Lab instruction • Several students indicated a need for more personal attention during the lab period. Learning from the experience of the UA Geosciences Department, preceptors (undergraduate teaching assistants) are going to be included beginning in the Fall of 1996. Preceptors will be selected from undergraduates who have completed the introductory course in environmental science with a grade of "A" or who are environmental science majors with a rank of sophomore or above. Geosciences has found that undergraduate students relate better to preceptors. Preceptors are not paid, but they can earn two to three credits for their teaching contribution. A weekly Teaching Workshop will be held to assist preceptors to improve their teaching skills. Geosciences has found this to be successful format and that preceptors not only make labs better, but also improved their own career skills and capabilities (Personal communication, Peter L. Kresan).

With a new manual, a re-organized presentation, and preceptors, the introductory environmental sciences lab course should become a more effective course. The final judgement will rest with future students. Hopefully we will not again see damning student evaluations as that quoted on the title page of this article.

Take-home lesson

The student survey, as simple as it was, provided the necessary feedback from the students that tipped the balance toward reformation of the environmental sciences laboratory course. It catalyzed faculty and staff involvement and lead to departmental changes that should make the course more interesting and beneficial to students.

I highly recommend inclusion of student opinion at any time, but particularly when revisions are envisioned in the content or teaching methodology of a given course. Also, I recommend that faculty broaden their view of a course by looking outside their own department to other departments teaching similar courses. We have learned much from the experience of Chemistry and Geosciences Departments and have been able to benefit from their experience by applying successful models for introductory laboratory courses to our own department. The faculty in the University Teaching Center also have proved invaluable in this exercise. I did not fully appreciate the depth of expertise required to be a good teacher and they have contributed greatly to my knowledge, a process I trust will continue for some time.

Literature Cited

Anderson, O.R. 1976. *The Experience of Science -- A New Perspective for Laboratory Teaching.* New York:Columbia University, Teachers College Press.

Brown, S.L. 1996. *Chemistry 104b Laboratory Manual.* Dubuque, IA:Kendall/Hunt.

Columbia University Teachers College. 1938. *Laboratory Techniques of Teaching -- The Contributions of Research to Teachers Planning the Individualiza tion of Instruction.* New York:Columbia Univer sity, Teachers College Press.

Flood, B.J., and J.K. Moll. 1990. *The Professor Business-A Teaching Primer for Faculty.* Medford, NJ:Learned Information, Inc.

Kresan, P. L. 1996. *Geosciences 103 -- Introduction to Geosciences Laboratory*. Tucson, AZ:Department of Geosciences, University of Arizona.

Riley, J.J. 1996. *Philosophy on Teaching Laboratory Techniques*. Unpublished paper.

Schwab, J.J. 1963. *Biology Teacher's Handbook. Biological Sciences Curriculum Study*. New York:John Wiley and Sons, Inc.

Tobias, S. 1990. *They're Not Dumb, They're Different -- Stalking the Second Tier: An Occasional Paper on the Neglected Problems in Science Education*. Tucson, AZ:The Research Corporation.

University of London Teaching Methods Research Unit. 1969. Proceedings of the Third Conference on Innovations and Experiments in University Teaching Methods. London:University of London.

Agricultural Policy Agenda: What's Important To Students?

Josef M. Broder[1], Department of Agricultural and Applied Economics, University of Georgia, Athens, GA 30602-7509

Abstract

Values that students place on contemporary agricultural policies are examined for three agricultural economics classes. Pre- and post-class rankings of values are presented by student background and major. This study demonstrates that students from all majors and backgrounds place a high priority on food safety and environmental issues; preserving the family farm is not a high priority of any of the student groups surveyed; students have not fully embraced the importance of internationalizing agriculture; and students from diverse backgrounds and majors have similar policy agendas that do not change dramatically while the students are enrolled in an economics course.

Introduction

Schools and colleges of agriculture have experienced major changes in the student clientele groups served by their educational programs. Historically, the mission of these schools and colleges was devoted to enhancing agricultural production as farmers and agricultural support groups sought the expertise of agricultural scientists and educators. Increases in production efficiency led to a decline in the number of farmers and an increase in the size and scale of agricultural producers, processors, and input suppliers (Seitz et al., 1994). With the decline in traditional clientele groups this mission has expanded beyond the farm gate as consumers, environmental, and animal rights groups have entered the policy arena. In response to this diverse clientele, schools and colleges of agriculture have changed their names, merged with other schools and colleges, downsized, or in some cases, been eliminated. At the curriculum level, an increasingly diverse faculty are offering new courses and degree programs that are attracting increasingly diverse students. These students are typically from non-agricultural backgrounds and, consequently, have different values and experiences than those of traditional agricultural students.

[1] Professor