chickens?", "Should we ship grain or meat to developing countries or should we teach them to produce their own food?" Input was only given by the instructors to help students express their questions more clearly. Very few strong opinions or simple answers to questions were raised in the discussion. It was concluded that the behavioral objective of the lesson had been met since students discussed candidly and inquisitively among themselves the relationship of poultry science to the world food situation. The lack of expressions of strong opinions or simple answers indicated also that the students had gained an appreciation for the complexity of this issue.

The grades on the first quiz ranged from five to ten out of a possible ten points with a mean of 7.87 and a standard deviation of 1.58 which was not significantly different from grades on other quizzes given in the course.

When students were asked at the end of the course to evaluate the clearness of the course objective, 71.5% of the students answered with a one or two. On the one to five scale the mean response was 1.9 with a standard deviation of 1.0. When asked how well the course material stimulated interest in the subject 85.7% of students responded with a one or two, with the mean response of 1.7 and a standard deviation of 0.9. These responses indicate that a clear and stimulating stage was set for an introductory course in poultry science.

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Landscape Design Students To Use Computer Software

Bradley W. Pedersen

Faculty members at the University of Minnesota Technical College, Waseca (UMW) are just completing work on a three year grant from the Fund for Improvement on Post Secondary Education (FIPSE).

The primary purpose of the grant is the creation of about 50 modules in various educational formats to be used as reinforcement units for the non-traditional agriculture student at UMW. A possible definition of non-traditional could be non-agricultural but in our sense it also more broadly refers to students having limited background in the biological sciences.

The methods by which the reinforcement units are implemented vary depending on the particular abilities of the students involved, the faculty member's philosophy of instruction, and the time restraints involved with the presentation of that particular subject area.

One of the modules developed in the landscape design area within the horticulture division, particularly the landscape design emphasis, was a reinforcement unit entitled **Design Characteristics of Woody Plants.** This particular module was developed to support the course sequence UMW offers in woody plant identification. In most colleges and universities, the plant materials course sequence could be from one to three separate courses depending on the number of plants to be covered and the room available in the curriculum to handle the credit requirements. At Waseca, one three-credit course and two one-credit courses are offered as the woody plants sequence. The curriculum change which expanded from one course to three has been too recent to evaluate its effects. However, indications are that this change will greatly increase the fundamental knowledge a student has when entering his or her first landscape design course. Also, the primary thrust of the plant materials sequence offered at most colleges and universities is toward identification and nomenclature of woody plants. The correct application of these materials in the landscape setting is usually only a secondary objective. Secondly, analysis of the specific plants studied in these courses indicates a decreased emphasis on the application of specific cultivars derived from parent species. Yet in many cases, it is the cultivars and their specific uses that are of major concern in the landscape design industry today.

The position in which the horticulture department at UMW found itself was much like that described above. Students enrolled in the landscape design

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program were not mastering applications of woody plant materials fundamental to initial landscape design coursework.

The typical landscape design student entering UMW will follow a sequence of coursework similar to the example listed below:

Technical Drawing	First Quarter
Deciduous Woody Plants	
Evergreen Woody Plants	Second Quarter
Landscape Planning	
Advanced Woody Plants	Fourth Quarter
Landscape Construction	
Advanced Landscape Planning	Fifth Quarter
Directed Studies (Landscape Design)	Sixth Quarter

This, of course, is only a limited portion of the curriculum; many other courses relate directly to the design sequence also.

The major problem develops during the second quarter landscape planning class at UMW. Students were not mastering the woody plant characteristics in their first quarter studies to a degree that would enable them to begin to apply that information to basic landscape design principles as presented in landscape planning.

The challenge was to create some way to alleviate the frustrations of students trying to develop technically correct landscape designs when they have had only limited exposure to the design characteristics of woody plants.

Existing written material was of little value in this instance. The time involved in looking up plant characteristics alone made this process too slow to be practical. Even more discouraging from the instructor's perspective was the tendency of student designers to use a limited variety of plant materials. Once a student did know a plant which had a certain set of characteristics, he or she tended to use that plant over and over again. It also became evident that students began their designs with specific plants in mind, rather than formulating a set of design characteristics for a certain location and then selecting plants that would best fit those characteristics.

The most effective way to present the correct information seemed to be in a microcomputer format. The particular goals of the module (software) development were: to provide a list of characteristics or traits of woody plants that are useful in landscaping, to provide a list of plants which fit one or any combination of those traits; and, lastly, to provide a glossary of technical terms used in the module.

With these three goals in mind, the software was programmed with three distinct levels of entry: selection of woody plants by name; selection of woody plants by trait; and glossary. This type of programming gives students maximum flexibility in that they can directly enter programs in the areas in which they are most interested.

Selection of Plants by Name

This section allows a student to retrieve all the available information on a particular plant by inputing the common or scientific name of the plant material. Students can obtain a list of plant materials contained in the program from an index located in the support manual which accompanies the software. A unique feature of the program is its allowances for errors in nomenclature. An incorrect name will automatically call up all names in the program which begin with the same first letter as that name. Students, by use of a selector key, may then call up the information on the specific plants they desire.

The specific information recorded in the program about each plant falls within the following categories:

File Name — Refers to the plant grouping requested, such as deciduous tree, evergreen tree, deciduous shrub, evergreen shrub, etc.

Growth Rate — A general reference to how fast a plant material grows in relationship to other plants in the same file name.

Texture — A general reference to the degree of fineness or coarseness of the plant in comparison with other plants in the file.

Height — A listing of heights (small, medium, large) indicating a range of height where one would most likely find a specific plant or, in the case of shrubs, a range designed by the type of pruning, whether it be formal, informal, or natural.

Spread — A listing of spreads (small and large) indicating a range of spread in which one would most likely find a specific plant at maturity or in the case of shrubs a range designated by the type of pruning, whether it be formal, informal, or natural.

Seasonal Interest — A categorization based upon information specific to such design characteristics as foliage, fruit, bark, twig, flower, or other traits of special interest. The seasonal interest category contains five separate sections — foliage, spring, summer, fall, winter.

Special Use — A one-word or two-word description of where a particular plant may be most frequently or appropriately found in a landscape setting. Examples would include foundation plantings, border plantings, specimen plants, etc.

Plant Peculiarities — This section includes five parts. It provides any information which may render a particular plant distinctive. Included in this section are notations of insect and disease problems, environmental requirements, soils, and species or cultivar information.

Selection of Plants by Trait

This segment of the program becomes the most important from a purely reinforcement standpoint. A student may key in one to as many as three numbers for any of the categories listed. Each number corresponds to a specific characteristic listed in the support manual

in the index. The program then generates a list of plants on the monitor screen which all have the traits that were requested by the student. The more traits a student inputs, the smaller the list of plants to be generated.

Glossary

Because some of the terminology employed in categorizing plant characteristics may not be recognized by the students using the software, they can leave the program at any point, punch in the code term for definition, read the term's definition and then reaccess the program at the point where they left off.

Although the computer module has only been used in three sections of the landscape design classes to date, students are showing greatly increased knowledge of design characteristics, they are employing broader ranges of plant materials, and they are exhibiting better retention of woody plant characteristics. This knowledge has been reflected positively in the quality of their landscape designs.

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"101" Independent Projects for Applied Microbiology

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Abstract

The project, **"101" Independent Projects for Applied Microbiology**, was designed to help students utilize applied microbiology skills by conducting individual research projects. The objectives of this project were to develop approaches and facilities to meet the needs of the student and to provide an educational benefit to students wishing to understand the role of microbes in natural environments.

The components of this project include "101" independent project ideas, a travel kit for field work, an activities center, report writing material, and a set of materials for reference. Each component pertains to problems that have been observed in previous research work.

The effectiveness of this project was determined by qualified microbiologists' evaluations of the individual projects and by student evaluations. The control group consisted of independent projects before the implementation of **"101" Independent Projects for Applied Microbiology**, and the experimental projects were those used during the project. The projects were judged on the basis of the student's ability to select a project rationally, the ability of the student to employ applied microbiology skills, and the student's aptitude in writing a scientific report.

Student opinion evaluations suggested that members of the experimental group were more confident that they could write a satisfactory report after using the individual project. Other questions on the evaluation form showed some slight improvement in the experimental responses.

Results indicated no significant difference between the experimental and control groups in their abilities to select rationally a project (Attribute 1). There was a slight, but not statistically significant, difference in favor of the experimental group in their ability to employ applied microbiology analysis (Attribute 2). There was a significant ($a = .05$) improvement in the experimental group's ability to write a scientific report (Attribute 3). This improvement signifies the success of this NSF research project, since the ability to present the findings of a study reflects the student's grasp of the concept and execution of the individual applied project.

Introduction

Education is a process or course of learning, instruction, or training that imparts knowledge, skill, and competence to an individual. If an educator has been successful, a student can skillfully and competently conduct an individual research project. Success in independent study is the major goal of all education.

Education in applied microbiology involves teaching a student how to apply instruction and training. Independent study in applied microbiology is

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