Table 3. Student Performance and Instructor Differences for Control and Treatment Sections of Agricultural Economics 100, The Ohio State University, 1973

Instructor		CAI	No CAI	Instructor Total	Instructor $\bar{X}$	
A	Class Size	51	66	117	61.8	
	Time	11 a.m.	9 a.m.			$F_{1, 261} = 1.05$
B	Class Size	83	65	148	63.5	
	Time	10 a.m.	2 p.m.			
Treatment Total		134	131	265		
	$\bar{X}$	64.9	60.6		62.8	

$F_{1, 261} = 6.76$

BIBLIOGRAPHY

1. Stitzlein, James L., David E. Hahn and Glenn C. Himes, "The Use and Evaluation of Computer Assisted Instruction for Teaching Introductory Principles of Production Economics," Department of Agricultural Economics and Rural Sociology, ESO No. 108, The Ohio State University, Columbus, Ohio, August, 1972.
2. Himes, Glenn C. and David E. Hahn, "Evaluation of the Use of Computer Assisted Instruction for Teaching Introductory Principles of Production Economics," Department of Agricultural Economics and Rural Sociology, ESO No. 158, The Ohio State University, Columbus, Ohio, August, 1973.

NACTA Manuscript No. 11/2/74/32

INCREASED LEARNING AND RELEVANCY IN A BASIC SOILS COURSE FOR TWO-YEAR AGRICULTURAL TECHNOLOGY STUDENTS[1]

Terence H. Cooper, Henry D. Foth, and Paul E. Rieke[2]

Learning accountability and forms of individualized learning have stimulated much of the recent research in education. Teachers are being challenged to account for the variability of students within their classes. Since learners vary widely in rate of achievement, interests, and motivation, methods of individualized instruction to account for these facts have been developed. Individualized instruction is not synonymous with providing individualized materials, but means "meeting the specific learning needs of each student" (3). Bjorkuist states that teachers are increasingly becoming managers of the learning process rather than dispensers of knowledge (2). With a properly managed individualized learning system, differences in the amount of student learning may be reduced, since students will be allowed their own learning pace and activities.

One of the key factors in the success of individualized instruction is the specification of objectives of instruction in behavioral terms. The most important characteristic of a useful objective is that it identifies the kind of performance which will be accepted as evidence that the learner has achieved the objective. This may be especially important in vocational education, in trying to produce a graduate who can be described to prospective employers in performance terms (4). The ability to describe in performance terms is directly dependent on behavioral objectives. For mastery of objectives to occur it is necessary that the slow learners be provided with more time to learn since over the same period of time slow learners will achieve fewer objectives that the high aptitude learner (2). In most situations, the amount of time required for the slow learner to obtain complete mastery is not available to him and he thus achieves less. Therefore, the responsibility of the vocational teacher is to manage the learning situation so that the slow learner can master the learning objectives and have some saleable skills at the end of a period of instruction. The true evaluation of a vocational training graduate will come when he has to prove his worth in the world of work.

Recent studies on the effectiveness of individualized instruction for vocational agricultural students in high schools (McCarley, 1969; McVey, 1970) have reported significant improvement over the lecture discussion methods for student achievement and course evaluation. In four-year degree programs in agriculture, favorable results have been obtained for individualized instruction in both the plant and soil science curricula (Green et al., 1973; Foth, 1973). An audio-visual tutorial program for presentation of course content was used in these studies.

Studies in Ohio have shown that the two-year student considers placement training and agricultural classes as the two most important factors for job placement after graduation (7). In the two-year agricultural technology programs at Michigan State University, it is known that there are wide ranges in capabilities among the students along with differences in psychological and motivational factors (5). Thus, many of the classes in the two-year programs at MSU meet the requirements for some form of individualized instruction.

This study was conducted to determine the effectiveness of an audio-visual tutorial, individualized learning program with a modified mastery learning format in basic soil science for the two-year vocational student.

Background to the Problem

Soil Science 051 is an introductory class in soil science required for the two-year agricultural student at Michigan State University in the turfgrass and landscape-nursery programs and is an elective for the floriculture majors. The class consists of approximately 100 students each year. Classes have been conventionally run by offering two lectures per week and one two-hour laboratory. Students in the class have shown a wide range in learning capabilities in three specific groups. In the past, it has been impossible to provide those students with slower learning capabilities all of the individualized help that they require to complete an understanding of the course. It has also been difficult to provide well-trained graduate teaching assistants with the necessary practical experience to be able to fulfill the student's desires for topical information. The learning facility available for the laboratories was mainly for a demonstration type of laboratory rather than an individualized learning experience.

Purpose of the Study

The main objectives of this study were to: 1) increase the relevancy of what the student learns in lecture and laboratory to the soil problems he will ultimately face on the job, 2) increase student achievement, 3) determine if the two-year agricultural technology student can learn effectively through the audio-visual tutorial mastery learning system, and 4) determine the

[1] Michigan Agricultural Experiment Station Journal Article Number 6893. This project was supported in part by a grant from the Educational Development Program, Michigan State University.

[2] Graduate Assistant and Professors, respectively, Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824.

feasibility of adapting this type of program to other areas in the two-year agricultural technology program.

Procedures Used

Implementation of procedural changes began with changes in the laboratory. Instead of having a two-hour scheduled laboratory, the students were scheduled for one hour per week in an audio-visual tutorial learning center. In this center, students listened to tapes, viewed slides, and participated in activities such as texturing soils, measuring pH, viewing soil profiles, etc. The learning center units, referred to as SLATES (Structured-Learning and Teaching Environments), were originally developed for use in the four-year introductory soil science course at Michigan State University (Soil Science 210). It was felt that many of the SLATES could be revised with minor modifications for use in Soil Science 051. Seven of these units were thus used with minor alterations in the workbook for the first seven weeks of the course. These SLATE materials essentially discussed those concepts and principles previously covered in the old laboratory, however, the student now had the opportunity to use as much time as needed to achieve the objectives for the units. For each of the seven units adapted from the 210 course, a Relevant Information Slate (or RIS) was developed to show how the concepts presented applied to the particular major. A separate RIS was developed for each of the three majors. The last two weeks in the term were devoted to the study of fertilizers and soil sampling. There was not appropriate material available from the 210 units and therefore, individual SLATES were developed on fertilizers and soil sampling for each of the three majors. A workbook was prepared for the students consisting of: behavioral objectives for each of the nine SLATE units and lectures, procedure outlines for each SLATE, lecture outlines, questions and problems, and self-test items with the answers provided at the end of each unit.

Mastery learning strategy as described by Block (1) and tested by Foth (6) include: 1) communication of learning objectives to the students, 2) opportunities for students to master objectives (usually some kind of individualization including the opportunity to learn at one's own pace). 3) feedback to the learner (formative ungraded tests). 4) opportunity for remedial learning, and 5) summative tests to establish degree of mastery or grade. Strategies 1-3 were included in the students' workbook. Opportunities for remedial learning were provided by having the learning center open during the week from 8 a.m. to 10 p.m. and on Saturdays from 8 a.m. to 3 p.m. Retests were also used to provide the students with an opportunity for feedback and through remediation to learn more and improve their point total. Retest exams were over the same material but consisted of different exam questions. The Office of Evaluation Services machine-graded the multiple choice exams and the summary data they provided indicated that the retests were comparable in terms of item difficulty and degree of discrimination with the first exams. Five exams were given during the quarter plus a comprehensive final. Only the highest score for a given test and retest was counted for determining the student's grade. The grading scale was determined before the quarter and all students were informed of the point totals required for the grade they wanted to achieve. The grading scale was similar to the one used in previous years which was determined by a curve.

Implementation of Audio-Visual Tutorial and Mastery Learning Procedures

Soil Science 051 was offered for the first time with the audio-visual tutorial and modified mastery learning procedures during the winter term of 1974. Students were scheduled for one hour in the learning center per week, but could return as often as they wanted to review or finish the week's SLATE unit. After completing the revised 210 SLATE unit the student would begin the 10 to 15 minute RIS unit to see how the material just completed applied to their particular major. After completing both tapes, students had questions, problems, and self-test items for study and review in the workbook to determine if they had a complete understanding of the subject matter presented.

Lectures were given on Monday, Wednesday, and Friday, when an exam was not scheduled. Four lectures were used to complement material covered in the SLATES for each two-week period. Lectures were used to cover material known difficult from past experience, explain concepts and principles not covered in the SLATES, and to provide encouragement for students.

Exams over the objectives were given on Friday with the retest the following Monday for those desiring to improve their score. A 5 to 10 minute question and answer period was held before each test to give the student further opportunity for remediation. Answers for each test were available immediately after the exam.

Comparisons to determine the effect of the changes were made with the previous two years' classes, 1972 and 1973, which were run on a conventional basis. In previous years there were two one-hour exams plus a final.

Results and Discussion

There was a significant difference (5% level) in high school grade point averages for Soils 051 students between 1972-73 and 1974. However, there was no significant change in the students first term agricultural technology grade point averages (GPA) and their scores on entrance exams between 1972-73 and 1974 (Table 1). Due to the large number of applicants presently seeking entrance to agricultural technology programs, those students with the lower high school GPA have not been selected. This has resulted in an increasing high school GPA for the students in Soils 051. However, the performance on entrance exams and their first term GPA's indicate that there have not been significant increases in the students' capabilities and/or motivation over this three-year period.

Table 1. Background Information on Students Enrolled in Soil Science 051 During 1972, 1973, and 1974.

	Years		
	1972	1973	1974
Number of students	104	89	99
Mean high school grade point average*	2.14	2.29	2.50
Mean first term Ag. Tech. grade point average	2.83	2.88	2.94
Mean scores on selected entrance exams			
Reading comprehension	153.1	154.2	153.8
Differential aptitude	50.8	52.5	51.6
Mathematics	35.5	35.9	37.3

* Difference between 1974 and 1972 and 1973 significant at the 5% level.

With the implementation of an audio-visual tutorial mastery learning format, there were significant increases in student achievement in 1974 over the previous years. This was determined by the significant change in grade distribution. In 1972-73, an average of 50 percent of the classes received a 3.0 or better. In 1974 this was increased to 70 percent (Table 2). There was also a significant increase (5% level) in the mean GPA's achieved. The mean GPA for Soils 051 for 1974, 1973, and 1972 was 3.17, 2.86 and 2.66, respectively.

Based on grades achieved in Soils 051 in 1972 and 1973, a multiple regression equation was developed using 1972-73 high school GPA's, first term agricultural technology GPA's and entrance exam scores to predict the performance of the 1974 student if no changes had been made in the course (Table 2). This equation accounted for 65 percent ($r^2 = .65$) of the variability in 051 grades for 1972-73 students. For the 75 1974 students selected the achieved mean of 3.25 was significantly higher (1%

Table 2. Soil Science 051 Grade Distribution for 1972, 1973, Actual Grade for 1974 and Predicted Grade for 1974.

Soil Science 051 Grade Received	Percent* of Students			
	1972	1973	1974 actual	1974 predicted**
4.0	17	20	43	13
3.0 - 3.5	39	36	27	37
2.0 - 2.5	35	33	21	44
1.5 or less	14	10	8	6

* Rounded to nearest whole number.

** Predicted from multiple regression equation (Soils 051 grade = .0027 + .376 high school GPA + 1.037 first term in agricultural technology + .012 differential apptitude score - .011 reading comprehension score).

level) than the predicted mean of 2.85. The factor that had the greatest influence on performance in Soils 051 was the GPA achieved by the student during the first term of the agricultural technology program.

Performance by low and high achievers was increased in 1974 over the previous years. Students were divided into two categories based on their achievement during their first term of agricultural technology. Significant changes in the Soils 051 grade distribution occur in the 1974 group for both those students who achieved above a 3.0 during their first term (Table 3) and also those who achieved less than a 3.0 (Table 4). Compared to 1972 and 1973 a higher percentage of 1974 students received a 4.0 or 3.0 and a lower percentage recieved a 2.0 or 1.0 with the audio-visual tutorial mastery learning techniques used.

Table 3. Achievement of Students in Soil Science 051 with a 3.0 or Greater GPA During Their First Term of Ag. Tech.

Grade achieved in Soil Science 051	Percent* of Students		
	1972	1973	1974
4.0	35	30	73
3.0	49	54	20
2.0	16	15	8

* Rounded to nearest whole number.

Table 4. Achievement of Students in Soil Science 051 with less than a 3.0 GPA During Their First Term of Ag. Tech.

Grade achieved in Soil Science 051	Percent* of Students		
	1972	1973	1974
4.0	4	3	24
3.0	19	18	28
2.0	48	59	34
1.5 or less	31	21	14

* Rounded to nearest whole number.

It was assumed that all of the factors in the mastery learning program contributed to the increase in student achievement. However, the opportunity for remedial learning or retesting was directly a measurable factor while other factors were evaluated indirectly. An average of 73 percent of the students who took a retest improved their point total. The group of students who did poorly (2.5 or less; 18 or less out of 25) on the first try had a higher percentage of students increase their point total than those students who achieved a 3.0 or more (19 or higher) on the first try (Table 5). An average of seventeen percent of the 18 or less group elected not to take a retest. If they had done so a higher precentage of students achieving a 3.0 or better may have been obtained. Ninety-eight percent of the students agreed or strongly agreed that they like the idea of a retesting procedure (Table 6).

Table 5. Results of the Retesting Procedure to Increase Student Learning, Averaged over Five Exams.

	Students who achieved 19/25 or more on the first try of an exam	Students who achieved 18/25 or less on the first try of an exam
Percent of Class	57	43
Percent that took a retest	35	83
Percent of those students who took a retest and increased their point total	55	84

Students were more aware of how concepts and principles related to their particular field of interest (turfgrass, landscape-nursery, and floriculture) in 1974 than in 1973. Although the questions were worded differently, 46 percent of the students felt they had no difficulty in relating topics covered to their field of interest and in 1974 this increased to 84 percent as indicated by their answer to evaluation questions (Table 6).

Table 6. Student Responses to Specific Evaluation Items on the Scale Where 1 Indicates Strong Agreement and 5 Indicates Strong Disagreement.

Item	Year									
	1973					1974				
	1	2	3	4	5	1	2	3	4	5
I had no difficulty in relating some topics to my field of interest.	7%	39%	16%	16%	7%					
The relevant information SLATE did show me how the particular topic SLATE applied to my major.						25%	59%	6%	7%	3%
I like the idea of being able to take a retest to improve my grade.*	22%	33%	14%	12%	11%	84%	14%	2%	0%	0%

* Students in 1973 did not have the opportunity to take retests but were asked this question at the end of the term.

The Students' Instructional Rating System (SIRS) prepared by the Office of Evaluation Services, Michigan State University, was used for course evaluation comparisons between 1973 and 1974. This rating system consists of 21 statements about class instruction and is designed to allow instructors to determine what attitudes their students hold toward various aspects of instruction. Students indicate their relative degree of agreement with respect to each statement. The SIRS composite profile rep-

resents five aspects of the learning situation with each one prepared by combining 4 of the 20 instructor items on the form. These profiles are intended to give an overview of the student's reactions to: instructor involvement, student interest, student-instructor interaction, course demands, and course organization.

The SIRS rating form indicated significant increases (5% level) in four of the five composite profile categories when comparisons were made between 1973 and 1974 (Table 7). There were also significant differences in all composite profile categories (5% level) when the 1974 students who achieved a 4.0 were compared to the 1974 students who achieved less than a 4.0. Those students who attained higher grades tended to rate the course higher.

Table 7. Item Means for Five Composite Profile Items Obtained from the SIRS Form.

Year	Composite Profile Areas				
	Instructor Involvement	Student Interest	Student-Instructor Interaction	Course Demands	Course Organization
1973	1.71	1.84	2.36	3.56	1.86
1974 (total) *	1.57	1.80	2.16	3.75	1.63
1974 (4.0) **	1.45	1.67	2.04	3.88	1.40
1974 (3.5 or less)	1.69	1.87	2.25	3.63	1.86

* Significantly different from 1973 in all areas but Student Interest at the 5% level.

** Significantly different from 3.5 or less in all areas at the 5% level.

Conclusions

Implementing the learning strategies presented in this paper such as audio-visual tutorial laboratories and modified mastery learning concepts resulted in: 1) an increase in student achievement (both low and high capability students), 2) an increase in awareness of how topics relate to on-the-job situations, 3) a positive increase in attitudes students have toward instruction, and 4) proving that the two-year agricultural technology student is capable of using the audio-visual tutorial laboratory as an effective learning tool. Students in Soil Science 051 have reacted favorably to the learning strategies used, not only by increasing their performance over previous years but also with their unsolicited comments of "I wish all courses were like Soil Science 051." It appears that extension of these learning strategies to other two-year agricultural technology courses with students of similar experiences and capabilities to those in the turfgrass, landscape-nursery, and floriculture programs at Michigan State University will provide similar results.

REFERENCES

1. Block, J. H. Operating Procedures for Mastery Learning. P. 64-76. In: Mastery Learning – Theory and Practice. Holt, Rinehart, and Winston, Inc. 1971.
2. Bjorkuist, David. "What Vocational Education Teachers Should Know About Individualized Instruction," Report No. Information Services 49, Ohio State University, Center for Vocational and Technical Education, November, 1971.
3. Connolly, J. J., and Sepe, Thomas. "Do Students Want Individualized Instruction?" U.C.L.A., Eric Clearinghouse for Junior College Information, Topical Paper No. 34. 1972.
4. Drawbaugh, C. D., Hall, W. L. Agricultural Education: Approaches to Learning and Teaching. C. E. Merrill Publishing Company. 1971.
5. Ecker, H. J. "The Transfer Dilemma" The Journal of the National Association of Colleges and Teachers of Agriculture, 17:48-50. 1973.
6. Foth, Henry D. "A Mastery Learning Program in Soil Science" Journal of Agronomic Education, 2:65-68. 1973.
7. Green, D. E., Stamp, D. L., Thomas, T. T. and James, L. L. "Student Response to a Personalized Learning and Narrated Tutorial System (PLANTS). I. A. Case Study." Journal of Agronomic Education, 2:5-9. 1973.
8. Iverson, N. J., Vincet, J. F., and Bender, R. E. Student and Program Characteristics of Technical Agricultural Programs in Ohio. College of Agricultural and Home Economics, Ohio State University. 1970.
9. McCarley, Walter W. "An Experimental Study to Evaluate the Effectiveness of An Individualized Instructional Method and the Lecture Discussion Method for Teaching Vocational Agricultural Classes," a Ph.D. Dissertation, Graduate School, Michigan State University. 1969.
10. McVey, Gary C. "An Experimental Evaluation of the Effectiveness of An Audiotutorial Method in Teaching Vocational Agriculture," a Ph.D. Dissertation, Graduate School, Iowa State University. 1970.

NACTA Journal Manuscript No. 10/30/74/31

ACADEMIC PERFORMANCE OF JUNIOR COLLEGE TRANSFERS

by W. F. Bennett, Associate Dean
College of Agricultural Sciences, Texas Tech University

The academic performance of students who transfer from two-year colleges to four-year colleges varies greatly. A study at Washington State University's College of Agriculture by Strait (1) indicates that transfer students 1) have some difficulty in the first semester after transfer, 2) experience an "adjustment shock," and 3) require special counselling.

Academic counsellors need some criteria for advising the transfer student to minimize his difficulty in coursework and his adjustment shock. One obvious criterion could be grades earned at the two-year college. A transfer student with a low grade-point average (GPA), for example, might be advised to take a minimum number of hours and perhaps "less rigorous" courses. On the other hand, a student with a high GPA might be advised differently.

To determine whether the GPA earned by a student while at the junior college is a good indicator of his ability to do well academically at the senior college, junior college transfer students, in the College of Agricultural Sciences at Texas Tech University during the academic year 1972-73, were included in a study for this comparison. The study included only students with between 12 and 66 hours of transfer credits and those who took at least 12 hours during the first semester at Texas Tech. The 137 students included were from 34 Texas and 2 Eastern New Mexico junior colleges.

The overall GPA of the student while at the two-year college was correlated with the first semester, second semester, and fourth semester overall GPA of the student while at Texas Tech University. The correlation between two-year college GPA and