

# Effectiveness of Supplemental Instructional Materials For Students Differing in Farm Experience

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## Abstract

*This study was undertaken to determine the effectiveness of supplemental instructional materials in improving quiz scores of students differing in farm background in a tillage and seeding unit of an introductory crop production course. The improvement from pretest to posttest scores was similar for students using the supplemental materials and students using only the normal materials, but improvement was related to amount of farm experience.*

Composition of the student body of colleges of agriculture has changed considerably in the past twenty years (4). One of the most significant aspects of the shifting enrollment pattern has been the rising number of nonfarm students (1). These students may have learning needs which differ from the needs of students who have grown up with farming (5).

Agronomy 114, Principles of Crop Production, is the introductory crop science course offered by the Department of Agronomy at Iowa State University. Approximately 30 percent of the students who enroll are from non-farm backgrounds (7). This course is presented through an audio-tutorial system of instruction called PLANTS — Personalized Learning and Narrated Tutorial System (2,3).

The PLANTS system incorporates the concept of minimum achievement (8). The student is allowed three attempts to pass a quiz covering the material for the current unit and two additional attempts at the end of the term if necessary. Students receive immediate feedback on quiz errors and are encouraged to study a second or third time until they have mastered the subject matter at the desired level of competence. A different quiz is provided for each attempt to minimize the chance of memorizing answers.

The provision of individualized assistance, the flexibility of the PLANTS system to accommodate individual learning styles and needs, and the minimum achievement concept are all aimed at optimizing learning by a large group of students with divergent backgrounds. In spite of the individualized nature of the course format, many nonfarm students appeared to experience an extra degree of difficulty and frustration in

mastering the material when compared to farm students. It was suspected that, for many nonfarm students, the initial level of the instructional materials might assume too much familiarity with farming equipment and practices. The objective of the study was to determine the effectiveness of using supplemental materials for improving the scores of the nonfarm students enrolled in Agronomy 114 in the Tillage and Seeding Unit (7).

## Methods and Materials

Three hundred and twenty-one students, enrolled in Agronomy 114 during Winter Quarter, 1980, and Spring Quarter, 1980, made up the study population. The final sample number for data analysis represented 63 percent of the study population. A reduction in the original sample number was due to failure to complete the questionnaire, pretest, or posttest. Cross tabulation contingency tables and chi-square statistics were used to test for possible biases introduced by the attrition; however, there was no statistically significant association between students omitted and any of the background factors.

Background data were collected by means of a questionnaire administered at the beginning of the course. These data included types of chores done on the home farm, crops-related work experience, ownership or rental of land, experience in machinery operation, membership in 4-H and FFA, number of years lived on a farm, and number of years of high school vocational agriculture instruction (7).

The study focused on the Tillage and Seeding unit that is one of thirteen units in the course (2), which was judged to be one of the units presenting the most difficulty to students without farm backgrounds.

Pretest and posttest scores were used to estimate the effectiveness of the supplemental instructional materials. The pretest and posttest consisted of open-ended questions that required identification of drawings of tillage implements, description of the function of several implements used in tillage and seeding, definition of terms used in tillage and seeding, knowledge of some specific environmental factors affecting tillage and seeding in North Central U.S., and ability to apply agronomic principles to situations concerning tillage and seeding. Questions in the posttest covered the same selected information tested in the pretest; however, question format and order of presentation of the questions were changed to minimize the possibility that correct responses on the posttest were conditioned by previous completion of the pretest. The posttest was administered 2 weeks

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Journal Paper No. 58, College of Agriculture, Iowa State University, Ames, IA 50011.

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after the completion of the unit. The pretest and posttest were each scored on the basis of a possible 100 points. Any improvement of posttest scores over pretest scores was considered the gain in knowledge of subject matter.

The control group of students used only the audio-tutorial instructional materials normally provided for the study of the Tillage and Seeding Unit. These included a tutorial cassette tape recording to guide students through study of the unit, the Agronomy 114 text (2), bulletins, slides, and filmstrips of tillage and seeding operations, tillage and seeding implement models, photographs, charts, brochures, journal articles, and sand-bench experiments and demonstrations.

The experimental group of students used a set of supplemental or preparatory instructional materials prior to studying the normal audio-tutorial materials. The intent of the supplemental materials was to familiarize students with some elementary aspects of tillage and seeding and the relationship of tillage and seeding operations to crop production as a whole. The supplemental materials attempted to include subject matter that was common knowledge among farm students but not among nonfarm students. It included definitions and descriptions of such basic terms as plow, disc, harrow, and cultivator; an overview of a crop production calendar, comparison of plant populations for various crops, visualization of the size of an acre; and a brief overview of tillage and seeding concepts to be presented in the unit. Approximately 30 minutes of study time was required to work through the extra materials that consisted of a taped narrative with an accompanying display, study sheet, and activity folder.

A randomized block, control group, pretest, posttest design was utilized (7). The multiple discussion sections in the course served as the blocking factor to partition any possible instructor effects. The data were analyzed by means of the Statistical Package for the Social Sciences Subprogram ANOVA with the option for Multiple Classification Analysis (6). Number of years lived on the farm was the covariate used in the analysis of covariance. Independent variables and categories within each variable are outlined in Table 1 and Table 2 in the Results and Discussion section.

### Results and Discussion

A comparison of means of pretest scores, posttest scores and gain, adjusted for discussion section effects, is presented in Table 1. Pretest and posttest scores increased as the amount of farm experience increased. Using the supplemental materials did not improve the posttest score, nor increase the gain score (posttest score — pretest score) compared to the control group. The covariate (number of years lived on a farm) had a highly significant (0.01 level) effect on the number of

**Table 1. Mean pretest and posttest scores of farm experience groups adjusted for discussion section effect.**

Independent Variable and Category	Mean Scores		
	Pretest	Posttest	Gain
Student farm experience			
Lifelong farm	54.92	66.20	11.28
Some farm	46.80	62.39	15.59
Nonfarm	31.37	56.46	25.09

points gained. The amount of gain more than doubled for the students lacking farm experience compared to students with lifelong farm experience (Table 1). These results indicated that farm students enter the course with an initial advantage in knowledge of tillage and seeding when compared to nonfarm students and some of this advantage is retained after students complete study of the same unit.

Table 2 shows a comparison of mean posttest scores for each of the four independent variables used in an analysis of covariance. The mean posttest scores are adjusted for the other 3 independent variables and for the covariate (number of years lived on a farm).

The use of supplemental materials did not affect posttest scores. More years of high school vocational agriculture instruction and more experience in operation of farm machinery and more work in crop-related jobs increased the posttest scores (0.10, 0.05, and 0.01 levels, respectively).

On the basis of these findings, one may conclude that this particular set of supplemental instructional materials was not effective in improving learning of nonfarm students in this unit. This ineffectiveness could result from (a) a failure of the supplemental materials to meet the stated objectives, in which case

**Table 2. Mean posttest scores for four independent variables used in an analysis of covariance.**

Independent Variable and Category	Mean Posttest Scores	
	Unadjusted	Adjusted <sup>a</sup>
1. Instructional materials used		
Supplemental materials	65.36	65.23
Normally provided materials only	63.54	63.66
2. High school vocational agriculture <sup>b</sup>		
None	61.68	63.60
1-2 years	62.77	61.22
3-4 years	69.78	67.16
3. Machinery operation experience <sup>c</sup>		
None	52.34	59.38
Occasional	60.59	61.22
Frequent	67.93	66.37
4. Crop-related job experience <sup>**</sup>		
None	48.22	54.20
1-4 seasons	61.27	65.05
More than 4 seasons	67.04	65.55

<sup>a</sup> Mean posttest scores adjusted for the other 3 independent variables and for the covariate (number of years lived on a farm).

<sup>b</sup> F-value significant at 0.10 level.

<sup>c</sup> F-value significant at 0.05 level.

\*\* F-value significant at 0.01 level. Crop-related job experience included detasseling, bean walking, haying operations.

development and testing of a different set of supplemental materials would be appropriate, or (b) the instructional materials normally provided were equally effective in meeting the stated objectives of the use of supplemental materials. Considering the quality and number of visuals, demonstrations, and models included in the instructional materials normally provided, it is likely that the learning in the Tillage and Seeding Unit has been raised to the extent that additional materials are superfluous.

When posttest scores were adjusted for the covariate of number of years lived on a farm, students who had experience in operating farm machinery or in a crop-related job scored better than those without such experience. It was not possible to identify a critical amount of practical experience because the categories within these two variables were broad and imprecise. The advantage of practical experience in obtaining higher posttest scores may simply be due to higher student interest in the subject matter. In this study the motivated student, with or without farm experience, may have been the student who had already obtained practical experience. If this is true, the difference in posttest scores of the two groups would indicate differences in motivation to learn subject matter rather than the ability to learn the subject matter.

It may seem surprising that high school vocational agriculture instruction did not have greater significance upon posttest scores. However, machinery experience and crop-related work experience effects were partitioned out in this analysis. Tillage or seeding is just one aspect of the high school vocational agriculture instruction and machinery operation experience and crop-related work experience may constitute a substantial part of the instruction in this area.

Student opinion of the supplemental materials was also solicited on the posttest. Eighty-three percent of the 118 students who commented thought that the supplemental materials would be helpful to nonfarm students. Nearly half of these students had farm experience and included in their comment that the supplemental materials were not helpful for farm students. Nine percent of the students who commented on the supplemental materials thought they were of no benefit to farm or nonfarm students. Eight percent of the students who commented thought that the idea of providing supplemental materials was good but that the particular materials provided were not helpful to themselves.

Although the extra materials had no effect on posttest scores, the majority of student comments indicated that the supplemental materials were of benefit to non-farm students. Either the students' perceptions were wrong or these materials provided a benefit that was not measured by the specific posttest used.

In summary, this study indicates that use of supplemental instructional materials for the Tillage and Seeding Unit in Agronomy 114 did not improve the scores of nonfarm students compared to the materials and teaching methods already used in the course. However, the normal audio-tutorial materials presented the students with numerous visuals and demonstrations of tillage and seeding concepts. Providing supplemental materials in units or courses without such extensive visuals and other materials may increase learning. The use of supplemental materials to narrow the incoming differences between students with and without farm experience may be more effective when used in all agriculture courses rather than in a single course or a unit within a course. Imposed practical experience, *per se*, may or may not be effective in improving the learning of students without such prior experience. The greater knowledge indicated for students with prior experience may be an indication of individual motivation. This question remains unanswered.

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