# A COMPARISON OF TRADITIONAL AND COMPUTER-BASED AGRISCIENCE INSTRUCTION FOR SECONDARY COURSES IN MISSISSIPPI

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**Abstract**

*The purpose of this research was to compare the knowledge and comprehension level of students enrolled in traditional and computer-based agriscience courses for the state of Mississippi. The sample size was 152 students. The research followed a causal-comparative design. Data were based on an achievement test designed by the researcher. The instrument was divided into four units of instruction. The overall test had a reliability alpha of 0.8879. Independent t-tests were run on the overall test and each unit. Overall, a significant difference favoring the traditional teaching method was found. A significant difference was found for three of the four units favoring the traditional instruction. Recommendations for further research were included.*

## Theoretical Framework

The agricultural education program provides a well-rounded, practical approach to learning through three components: Classroom education in agricultural topics; hands-on supervised agricultural career experiences; and FFA, which provides leadership opportunities (Lee, 2000). These components are recognized as vital and interrelated components of a successful agricultural education program (Phipps, & Osborne, 1988).

Traditionally, agricultural education curricula was designed to be both practical and applicable for students who were returning to the farm, concentrating on the "how" of agricultural production rather than the "why". However, curriculum design efforts throughout the 1990s in agricultural education have moved toward integrating science-based material. These efforts are providing "agriscience" instruction, which is designed to meet the needs of a larger, more diverse, and broader clientele (Osborne & Dryer, 1998). The organized body of knowledge referred to as the science of agriculture is deeply rooted in the sciences that contribute to agriculture (Osborne, 1994). The terminology "agriscience and technology" describes the areas of agricultural education that integrates science-based instruction into the discipline. "Agriscience" better reflects an emphasis on science in the curriculum. New approaches are being designed to better incorporate these changes (Lee, 2000).

Since the American Association for the Advancement of Science (AAAS) advocated teaching science as a process, educators have been interested in improving the science process skills of students (Burchfield, 1995). Science process skills are used to investigate and study the world (Funk, 1985). These science-processing skills have been classified as two major categories; basic science processing skills and integrated science process skills. Basic processing skills include: observing, inferring, measuring, communicating, classifying and predicting. Integrated science process skills include: controlling variables, defining operations, formulating hypothesis, interpreting data, experimenting and formulating models (Padilla, 1986).

All students must comprehend basic science concepts. Integrating science into agriculture would not only strengthen agricultural curricula, but also more effectively teach science (National Research Council, 1988).

Integrating science-based curriculum is the focus for agricultural education in the state of Mississippi. Two main approaches are available for Agriscience education in the state. One approach that this study discussed is the traditional approach of teacher led instruction. The second approach studied is computer based module instruction. The instructional content of the two introductory agrisciences course was similar, however, the two approaches have not been tested and compared to determine if one affords greater student achievement than the other. Research to show if one method yields a higher level of knowledge and understanding is necessary to determine future direction for teaching Agriscience in the state.

## Purpose

The purpose of this study was to compare the knowledge and comprehension levels of students enrolled in the "Introduction to Agriscience" conventional teaching method and the "Concepts of Agriscience Technology" computer module based course. Mastery of these two levels is essential for learners to move to higher levels of cognition in the science of agriculture. (Bloom, Englehart, Fuest, Hill and Kratwhol, (1956) Determining if a significant difference in student achievement exists between the two teaching methodologies.

## Null Hypothesis

The following five null hypothesis were tested in this study:

$H_o$-1: Based on the entire instrument tested, no statistically significant difference will exist between the knowledge level of students in the "Introduction to Agriscience" conventional teaching method and the "Concepts of Agriscience Technology" computer module based course.

$H_o$-2: For the individual section of "Introduction to Principles of Animal Science", there will be no significant difference in test score means between the students knowledge and comprehension of each curriculum.

$H_o$-3: For the individual section of "Introduction to Principles of Soil Science", there will be no significant difference in test score means between the students knowledge and comprehension of each curriculum.

$H_o$-4: For the individual section of "Introduction to Principles of Plant Science", there will be no significant difference in test score means between the students knowledge and comprehension of each curriculum.

$H_o$-5: For the individual section of "Principles of Mechanical Technology in Agriscience", there will be no significant difference in test score means between the students knowledge and comprehension of each curriculum.

## Procedures

Borg and Gall (1989) defined research design as "a process of creating an empirical test to support or refute a knowledge claim" (p. 324). The research design for this study is ex post facto or causal-comparative design. According to Ary, Jacobs and Razaviech (1990) causal-comparative attempts to determine the causes for differences that already exist in groups of individuals. Furthermore, the major advantage of the casual-comparative research design is that it allows researchers to examine cause and effect relationships under conditions where experimental manipulation is difficult or impossible. Another advantage is that many such relationships can then be studied in a single research study. However, a disadvantage to this design is that determining casual patterns with any degree of certainty is difficult (Borg, & Gall, 1989). Ary, Jacobs and Razaviech (1990) suggest that a method that provides partial control in a casual-comparative study is to match the subjects in the control and experimental groups on as many variables as possible. The researcher sought to determine if the presence of computer based modules had an effect on student performance on a knowledge base instrument. The variables in this study could not be manipulated, therefore a causal-comparative design can be used (Ary, Jacobs & Razaviech, 1990).

In casual-comparative, research the independent variable has already taken place and possible effects on an observed dependent variable are studied (Ary, Jacobs & Razaviech, 1990). The dependent variable was the students' mean scores on the knowledge-based achievement test. This posttest was representative of course material covered by both teaching methods used in this study. The independent variable was teaching method.

Since the sample was not randomly selected, threats to internal validity must be considered. Both history and maturation were controlled by the fact that both treatments were subject to similar historical events and time. By not giving a pretest, the threat of interaction between testing and treatment was controlled. Matched pairs of schools determined the selection of subjects. Schools were also matched based on their location in the state, size of the school, and teacher experience.

The two teaching methods researched in this study are curriculum-guided methods of instruction for the state of Mississippi. The concepts, methodology and findings of this study can apply to other settings. However, others wanting to replicate this study may need to redesign the instrumentation based on possible curriculum changes.

The total population consisted of high school students in grades 9-12 enrolled in either the AEST Concepts of Agriscience course or Introduction to Agriscience course in the state of Mississippi for the 2000-2001 school year. Students currently enrolled in these programs were chosen to reduce the risk of history and other extraneous variables. The target population for this research was the seven schools that began the AEST program in 1999 and matched schools that used the traditional curriculum. This was the second year these AEST programs were in operation. The instructors in these programs were more knowledgeable about the module programs and were more comfortable with the technology and systems than other schools who started using the AEST curriculum this year. Using the programs that have already completed one full school year was an attempt to make the research more valid. Schools using the Introduction to Agriscience curriculum were matched by the following characteristics, location in the state, size of the school, and teacher experience. The researcher, with the State Supervisor of Agricultural Education and a professor of agricultural education determined these matches. Fourteen schools were asked to participate in this study. Ten schools agreed to participate while nine schools completed the research study. However, due to the matched design, eight schools contributed data that was used in this study.

Only students with both student assent and parental consent forms signed and returned were allowed to participate and take the instrument posttest.  The sample for this study was 152 students enrolled in either course. Seventy-three students were enrolled in the Concepts of Agriscience course and 79 were enrolled in Introduction to Agriscience.

## Instrumentation

This research is based on an achievement test designed by the researcher. Questions used for the research instrument were based on the shared objectives and content of both curriculums. The Mississippi State University IRB approved this study and instrument before the instrument was administered.

This instrument was a 60-question multiple choice test divided into the four units previously discussed. Each unit provided equal distribution to information covered in the described units. The researcher chose to use 60-multiple choice questions so the test could be completed in a normal class period. The main reference used for the development of the instrument was the textbook referenced by both curriculums. Other sources included curriculum referenced material.

It was predetermined to use 60 questions for the final instrument. To determine the questions used for the instrument, an 80-question instrument was developed and administered to a pilot test group. This group of agriscience students was not a part of the research study. Questions were divided into the four subgroups. Tests were scanned and graded by NCS exam SYSTEM II program provided by Test Services at Mississippi State University. The item analysis report determined by exam SYSTEM II was used to analyze the questions administered. To determine the five questions per section to delete, the upper quartile, lower quartile, discrimination index and difficulty factor were used. The upper quartile showed the number of students in the top 25 percentile of the test and their selected alternatives for each question. Likewise, the lower quartile showed the lowest quarter of the test group and their selected alternatives. The discrimination index measured the ability of an item response to discriminate between those individuals who attained a high score and those who attained a low score on the test. The difficulty factor measured how difficult the question was to answer correctly.

Questions were analyzed by section. First, questions with the lowest difficulty factor were noted. Next, the discrimination index value for these questions were compared. The questions with higher discrimination values for the correct answers implied less discrimination. Differences in upper and lower quartile scores were compared. The questions with the lowest upper quartile score and highest lower quartile scores were highlighted. This meant that fewer students that scored high overall, scored well on that question.  Considering these measurements, the five lowest questions were deleted

The content validity for this instrument was established by a panel of experts in agricultural education for the state of Mississippi. This panel consisted of faculty from the Department of Agricultural Information Science, and representatives from the State Department of Education. A current Mississippi Vocational Director and current Mississippi Agriscience instructor not participating in this study also provided insight on the validity of the instrument. The panel reviewed for face validity, clarity and correctness (Mississippi Curriculum Framework for Introduction to Agriscience).

Suggestions made by the panel were considered and modifications to the instrument were made prior to the pilot test.

To determine the reliability of the instrument used for this study, alpha scores were tested on all participants as one group. Alpha is the appropriate method to use for computing reliability for the Kuder-Richardson formulas (Borg & Gall, 1989). SPSS was used to determine the overall and individual alpha scores. First the overall alpha or K-R20 score was determined to be .8787. Individual unit alphas were also determined as seen in Table 1.

Table 1. Individual Unit Alpha Scores

| Unit Title | Number of Items | Alpha |
|---|---|---|
| Introduction to Principles of Animal Science | 15 | 0.7833 |
| Introduction to Principles of Soil Science | 15 | 0.7923 |
| Introduction to Principles of Plant Science | 15 | 0.5453 |
| Principles of Mechanical Technology in Agriscience | 15 | 0.6766 |

Each unit consisted of 15 questions. Although this estimate of internal consistency provides a conservative reliability, the individual alpha levels were not as high as desired. Also computed was the individual item alpha, if that question was deleted. Usually, the more items on a test, the higher the reliability. This is due in part to the fact, the more items in a test, the better estimate of a person's true score can be made. However, this is not always true. As seen in Table 2, the removal of one question per section increased the alpha of that section. Table 2 identifies which question was deleted from the test for each unit as well as the new alpha level for each section.

The deletion of four questions increased the overall alpha as well. The new alpha for the test as a 56-question instrument was 0.8879. This is considered a moderately-high reliability score (Ary, Jacobs and Razavieh, 1990). The sections introduction to principles of animal science, introduction to principles of soil science and principles of mechanical technology in agriscience were considered moderate. The reliability of the introduction to principles of plant science is not as high as desired. This must be considered when analyzing the findings of this section.

Table 2. Alpha Level with One Item Deleted

| Unit Title | Question Deleted | New Alpha |
|---|---|---|
| Introduction to Principles of Animal Science | 11 | 0.7893 |
| Introduction to Principles of Soil Science | 19 | 0.7981 |
| Introduction to Principles of Plant Science | 34 | 0.5714 |
| Principles of Mechanical Technology in Agriscience | 57 | 0.7049 |

**Results**

The hypotheses were based on the instrument data collected for the experimental computer assisted instruction group and the comparison traditional instruction group. Overall mean, standard deviations and percentages were calculated as seen in Table 3. This shows that overall, the students enrolled in the Introduction to Agriscience traditional teaching method course had a higher mean than the students enrolled in the Concepts of Agriscience computer-assisted module course. The percent of questions answered correctly for the traditional method students was 8.83% higher than the test percentage of computer-assisted module students.

Table 3. Mean Differences for Overall Test Scores

| | N | Overall Test | | Percent Correct |
|---|---|---|---|---|
| | | Mean | SD | |
| Computer | 73 | 25.88 | 9.09 | 46.21 |
| Traditional | 79 | 30.82 | 10.41 | 55.04 |

Means and standard deviations were calculated for each of the four unit sections (Table 4). For the purpose of reporting the findings, “Unit 1” is Introduction to the Principles of Animal Science, “Unit 2” is Introduction to the Principles of Soil Science, “Unit 3” is Introduction to the Principles of Plant Science, and “Unit 4” is Principles of Mechanical Technology in Agriscience.

Table 4. Mean Differences in Variables Across Units

| Method | N | Plant Science | | Animal Science | | Soil Science | | Mechanical | |
|---|---|---|---|---|---|---|---|---|---|
| | | | SD | M | SD | M | SD | M | SD |
| Computer | 73 | 7.48 | 3.45 | 5.42 | 2.57 | 5.93 | 2.61 | 7.04 | 2.77 |
| Traditional | 79 | 9.05 | 3.21 | 7.44 | 3.99 | 6.01 | 2.72 | 8.32 | 3.31 |

Note. A score of 14 was the maximum score for each unit.

Independent sample t tests were run to determine if a significant difference existed between the scores of students in the experimental computer-assisted instruction course and the comparison traditional instruction course. The *a priori* alpha level of 0.05 was set. Therefore, tests having an alpha of 0.05 or below would reject the null hypothesis. However considering the family-wise error, the overall alpha for the study was 0.226. The family wise error rate is considered when multiple tests are run on the same data set. Family-wise error is a type 1 error, reducing the power of the study. For this study the family-wise error was calculated as:

$$
\begin{aligned}
FW_{error} &= 1-(1-\text{alpha})^{\#\text{ of tests}} \\
&= 1-(1-.05)^{5} \\
&= 1-(.95)^{5} \\
&= 1-.774 \\
&= 0.226
\end{aligned}
$$

First, an independent sample t test was run on the overall scores of the two groups compared. Next, *t*-tests were run on each of the four units of the test (Table 5). Based on Levene’s Test for Equality of Variances, equal variance was assumed.

Table 5. Summary of t test Significance of Teaching Methods

| Unit | T-score | df | alpha |
|---|---|---|---|
| Overall Test | -3.109 | 150 | .002 |
| Animal Science | -2.907 | 150 | .004 |
| Soil Science | -3.67 | 150 | .001 |
| Plant Science | -.19 | 150 | .851 |
| Mechanical Technology | -2.57 | 150 | .011 |

Testing of $H_0$-1

The first null hypothesis stated that no statistically significant difference exists between the knowledge level of students in the “Introduction to Agriscience” conventional teaching method and the “Concepts of Agriscience Technology” computer module based course based on the entire instrument. This was tested by analyzing the means of both test groups overall scores. Fifty-six questions were used for this instrument. The traditional teaching method “Introduction to Agriscience” course mean, at the .05 level of significance, was higher than the computer-based “Concepts of Agriscience” mean. Therefore, the null hypothesis was rejected. To determine where the significant difference lies, the remaining hypotheses were tested.

Testing of $H_0$-2

The second null hypothesis stated that no significant difference would be found for the means of the Introduction to Principles of Animal Science section for the two curriculums compared. The Concepts of Agriscience computer assisted instruction mean for this section was 7.48. The Introduction to Agriscience traditional instruction mean was 9.05. A significance of .004 was found with an independent *t*-test. Therefore, the null hypothesis was rejected.

Testing of $H_0$-3

The third null hypothesis stated that no significant difference would be found for the means of the Introduction to Principles of Soil Science section for the two curriculums compared. The Concepts of Agriscience computer assisted instruction mean for this section was 5.42. The Introduction to Agriscience traditional instruction mean was 7.44. A significance of .001 was found with an independent *t*-test. Therefore, the null hypothesis was rejected.

Testing of $H_o$-4

The fourth null hypothesis stated that no significant difference would be found for the means of the Introduction to Principles of Plant Science section for the two curriculums compared. The means compared were similar. The Concepts of Agriscience computer assisted instruction mean for this section was 5.93 and the Introduction to Agriscience traditional instruction mean was 6.01. A significance of .851 was found with an independent *t*-test. Therefore, the null hypothesis was not rejected.

Testing of $H_o$-5

The fifth null hypothesis stated that no significant difference would be found for the means of the Principles of Mechanical Technology in Agriscience. section for the two curriculums compared. The Concepts of Agriscience computer assisted instruction mean for this section was 7.04. The Introduction to Agriscience traditional instruction mean was 8.32. A significance of .011 was found with an independent *t*-test. Therefore, the null hypothesis was rejected.

## Conclusions

The following conclusions about the Concepts of Agriscience computer-assisted instruction course and the Introduction to Agriscience traditional instruction course were drawn from the findings of this study. Since no other studies could be found that compared computer-based instruction and traditional instruction for an introductory to agriscience course, this study provides uniqueness when compared to related literature.

Overall, students enrolled in the Introduction to Agriscience course had a higher knowledge and comprehension level as determined by the research instrument than students enrolled in the Concepts of Agriscience computer based module course. This study revealed a difference in overall mean test scores favoring the traditional instruction method over the computer based modules instruction method. This research compared student's knowledge and comprehension. Higher levels of cognition were not considered.

A 56-question instrument was divided into four units that were similar in content of the two methods. The reliability of three units were considered high-moderate. These unit mean scores found a significant difference in students mean scores between the Introduction to Agriscience traditional course and Concepts of Agriscience computer module based course on all units except Plant Science. These significant differences favored the traditional instruction method.

Based on the findings of this research, it is concluded that the knowledge and comprehension level of students enrolled in Introduction to Agriscience traditional method curriculum was higher than students enrolled in the Concepts of Agriscience computer-based module curriculum.

## Implications

Computers can provide students enjoyable tools in which to learn and understand information thus improving academic performance (Kay, 1991). Schwartz suggested that computers could provide a new alternative method of instruction and improved learning methods, which can increase students' potential for being competitive in today's society (1991). However, this study found traditional teaching to be more effective than the teaching modules in terms of student knowledge and comprehension. Although the findings were limited to students enrolled in the Concepts of Agriscience course or Introduction to Agriscience course for the state of Mississippi, this research could have implications for states using computer-based module instruction. Concerns may also result from funding sources that provide resources for module-guided curricula, if computer assisted instruction is ineffective. Part of the agricultural education mission is to prepare individuals for careers. If computer-assisted module instruction is not preparing individuals in its current state, improvements need to be determined so that the best educational setting is provided.

Other research studies compared achievement, but also assessed student's attitudes, motivation and learning styles. Christmann and Badgett (1997) found that on average, students receiving traditional instruction supplemented with computer-assisted instruction attained higher academic achievement than those only receiving traditional instruction did. Although Roberts (1999) studied web-based instruction as a primary and supplementary delivery of instruction, learning styles and students attitudes were also considered. Roberts (1999) found students academic performance to be equally successful regardless of teaching method or learning style. Perhaps computer-based modules don't offer the variety that encourages higher student performance.

Miller and Honeyman (1996) found that both field-dependent and field-independent learners performed better when a variety of teaching methods was incorporated in the curriculum. Miller (1997) described the field-dependent learner as one who prefers defined goals and organization and desires positive reinforcement from the teacher and has well-developed social skills. Miller (1997) described the field-independent learner as one who prefers to develop his or her own structure for learning activities and cares little for positive reinforcement from the teacher. The student likes competition, is socially independent and has poorly developed social skills (Miller, 1997). If computer-assisted instruction is best suited for field-independent learners, the learning styles of students should be determined to provide the best learning environment for the students.

While student-teacher interaction was not part of this study, research had been found to suggest computer based modules provide sufficient interaction between both parties. Palmer (1999) studied students' perceptions of high quality science teaching and found attributes of "good teachers". Variety, hands-on activities, fun and interesting activities and clear explanations were some of the attributes found. Also, important were additional comments including allowing individual and group activities, the use of interesting approaches to raise subject interest, and the importance of having student interaction.

Student attitudes and anxieties toward computers could be related to differences found. Based on a study of traditional instruction and World Wide Web instruction, Sexton (2000) found that participants who had computer anxieties found higher levels of cognition tasks over the web to be challenging.

## Recommendations

Based on the finding and conclusions of this study, the following recommendations were made for future study.

More research studies of this nature involving computer-based instruction and traditional instruction in the area of agricultural education and agriscience are recommended. Specifically for the state of

Mississippi, more studies with a higher percentage of the population are recommended. Seven AEST programs began in 1999. These schools with matched schools were asked to participate in this research. Today over 20 programs use this curriculum. Possible incentives might be offered to either teacher or student to increase participation. More research regarding secondary agriculture students would improve the generalization of these findings.

Students were not asked to supply demographic data. Research including differences in age, gender, race, academic performance and grade levels are recommended for future studies. If provided this information, it could be determined if any of these variables had an effect on achievement of the test as well as experimental mortality. Participants could provide information regarding when they received the instruction of the units tested. Differences in time and retention should be studied for further research.

Research to include difference in student motivation, attitudes and learning styles are suggested. Findings from this type of research could determine if student's reaction to the different teaching methods is significant. This would include alternate forms of instrumentation to determine differences. The Group Embedded Figures Test is commonly used to determine if individuals are field dependent or field independent. Differences, which exist in the learning styles of the individual, could affect achievement based on the teaching method.

Research has shown that computer-assisted instruction has been effective in some areas of study. The degree to which computer-assisted instruction is used should be studied. Perhaps curriculum should be evaluated to determine if computer-assisted instruction could be used more as a supplementary method of instruction used in conjunction with traditional teaching methods. Further study in this area is recommended.

Although mastery at the lower levels of cognition was not shown, research to include all levels of cognition is recommended. Increased reliability of instrumentation could effect data results.

Computer module instruction is only one form of computer-based instruction. More research of this nature should be done in other areas of agriculture where applicable. As society continues to change, so will the instruction and education methods used in educational settings. Computer-based instruction is relatively new in the area of agriscience. More research is needed to explain the effectiveness of computer based instruction as compared to traditional methods of instruction before serious financial commitments are made.

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