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Factors related to the learning of participants in the Ohio pesticide private applicators instructional program

Okoro, Daniel, Ph.D.
The Ohio State University, 1993
FACTORS RELATED TO THE LEARNING OF PARTICIPANTS IN THE OHIO
PESTICIDE PRIVATE APPLICATORS INSTRUCTIONAL PROGRAM

A DISSERTATION

Presented In Partial Fulfillment of the Requirement for the
Degree Doctor of Philosophy in the Graduate School of The
Ohio State University

By

Daniel Okoro, B. S., M. S.

* * * * *

The Ohio State University
1993

Dissertation Committee

Larry Miller
John D. Rohrer
Jo Jones

Approved by

Larry E. Miller
Adviser
Department of Agricultural Education
DEDICATION

This study is dedicated to my wife, Patricia Okoro, without whose love, financial and moral support, endurance, and motivation my graduate education would not have been possible.
ACKNOWLEDGEMENT

I would like to acknowledge the following people who contributed in no small measure to make possible the completion of this study. To Dr. Larry E. Miller, my major adviser for my graduate program and this study, for his patience, understanding, excellence guidance, and exceptional interest in my graduate program and this study. You are solely responsible for obtaining the funds without which this document would never have been written. Thank you for laboring over the words as if they were yours and for making this study a great learning and exciting experience.

Special gratitude is expressed to Drs. John D. Rohrer and Jo Jones for diligently and faithfully serving as my reading committee and to Drs. Janet Henderson and David Hahn, for serving in my graduate committee. Your wise inputs are greatly appreciated.

To my brothers Mr. Job Njoku and Mr. Joe O. Obasi, and to my sister Mrs. Oyiri Nwankwo for their continuous support and encouragement throughout my education. Very sincere gratitude to my brother and sister in-laws Mr. Gilbert Okereke, Mr. & Mrs. John Dibia for caring and loving my children as theirs. To Dr. Agom Eze, Dr. Chigozie Ogbu,
Mr. Daniel Okorafor, and Mr. Bill Okwe Nwokereke for sponsoring my graduate study in the United States.

To The Church of Jesus Christ of The Later-Day-Saints, Dr. & Mrs. Ojimadu A. Ohajuruka, Mr. & Mrs. Christopher Ogbonna Ogbo, Mr. Godwin Ogbo, Miss. Saa Otaru, and my good neighbors Mr. & Mrs. Raphael O. Nnachetam. Your prayers, support, and encouragement during some of the dark hours of this study were greatly appreciated.

To my good friend Dr. Don Ibezim. I thank you for years as a co-graduate students, and now as a friend. Thank you for the listening ears, watching eyes, and the caring about my family and my progress. Your assistance in data collection and analysis were highly appreciated.

To Joanne Kick-Raach for her untiring efforts to read and improve the content and terminology of the instruments used for this study. To the Cooperative Extension Agents who participated in this study. Your cooperation was appreciated.

Finally, to my children Nwanneka, Michael and Nnenna for their understanding and patience during my long absence; Joseph, Enyinna, and Daniel for their patience and encouragement throughout this study.

Words alone cannot express my sincere gratitude. I am greatly indebted to all of you.
VITA

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Chapter 1

INTRODUCTION

Wealth and competitiveness of the nation, as well as that of individual Americans, depend increasingly on education, including adult education and training. Adult education equips participants to continuously identify what they need to know and to learn it equally (Bennett, 1992).

Jessen et al. (1961) emphasized that no society can depend solely upon learning by chance or self-education. As a society grows more complex, an intensification of the formal instruction available is required to insure adequate lifelong learning. A specific machinery to achieve that end is necessary. An adult education program is that machinery.

As the nation moves into the last decade of this century, farmers are faced with an explosion of knowledge and concurrent changes in agricultural technology especially in the area of pesticides. Technological changes in agriculture require a transformation of scientific knowledge into practical, applicable, adaptive systems that meet the challenge of increased productivity (Raman, 1992). Because of the explosion of new agricultural technologies, societies must necessarily have well trained people to handle such rapid technological change. One of the purposes of adult
education is to develop in adults the skills to handle changing technology.

Gayle (1990) emphasized that as a result of the dramatic changes in technology, business, and industries, adult educators will need more services related to updating technical skills and knowledge. New curricula will have to be developed to meet the needs of consumers in the emerging sciences and technologies. Educational institutions will have to initiate new methodologies and alternative delivery systems.

Boone (1989) noted that extension education is a system of nonformal education and is a field of professional education practice aimed at: (a) teaching people in their context and life situations how to identify and assess their own needs and problems, (b) helping them acquire the knowledge and skills required to cope effectively with those needs and problems, and (c) inspiring them to action. The 1963 National Association of State University Land-Grant Colleges Committee reported that the mission of the Cooperative Extension Service (CES) was:

to aid in diffusion among the people of the United States useful and practical information on subjects relating to agriculture, home economics, and rural energy and to encourage the application of the knowledge by instruction and practical demonstration of improved practices on technologies, in agriculture, home economics, and rural energy and subjects relating thereto to persons who desire them.
In recent years, the use of pesticides in agriculture has increased greatly throughout the world. At the same time, public concern over the amounts of agrochemicals that are being applied to the land, and their possible side-effects on human and animal health has risen sharply. Scientists, farmers, and the general public are concerned that pesticides are being applied ever more widely but with less and less discretion (Bohmont, 1990).

If Extension expects to meet the challenges of increased use of pesticides, it has to maintain the momentum of change. Extension needs to expand research into the variety of possible delivery structures, type of curriculum and instructional methods to adequately respond to the rapid increase in the use of pesticides and their possible side-effects on human and animal health.

To combat the lack of knowledge about the use of pesticides, the administrator for the U.S. Environmental Protection Agency (EPA) and the Secretary of the U.S. Department of Agriculture (USDA) executed a Memorandum of Understanding on June 14, 1972. The memorandum required the Extension Service (ES-USDA) to collaborate with EPA to develop and conduct training programs for pesticide applicators through State Cooperative Extension Services concerning safe and effective methods of application, use and storage, disposal of excess pesticide and pesticide
containers, and improvements relating to air, water, and soil pollution. The EPA should furnish the Extension Services with copies of training materials on pesticides and the environment.

The Federal Insecticide, Fungicide and Rodenticide Act, amended on October 21, 1972 by Congress via the Federal Environmental Pesticide Control Act (henceforth known as "Amended FIFRA") required that all persons applying or supervising the application of restricted use pesticides be certified as competent in such use.

Liability relating to legal responsibilities of the pesticide applicator is taught during certification. An example of this liability regards a farmer's use of pesticides and losses to other's property such as destruction of beehive, fish kill, crop damage, improper disposal, human illness, bird kill, field runoff and abandoned facility pollution by misapplication of pesticides and contamination. These requirements applied both to commercial and private applicators.

Most persons affected by certification requirements have been using pesticides for years. However, new products come on the market each year and problems not previously recognized with older compounds continue to surface. Training and certification are expected to upgrade the knowledge of pesticide users across the nation so they can
better deal with pest control problems and minimize possible risks to themselves and others, and avoid environmental hazards, such as pollution of waterways or wildlife areas.

Certification is the responsibility of a lead agency in each state, which is the Ohio Department of Agriculture (ODA) in the state of Ohio. Competence of each private applicator shall be verified by the ODA according to standards established by applicable state and federal laws and regulations. The training programs were to be shaped by state lead agencies to conform to both state and federal regulations regarding pesticide use. The certification system shall employ a written or oral examination procedure, or such other equivalent system as may be approved as part of the state plan. Training, thus, becomes an essential process leading toward certification.

The issue is "What are the basic skills needed by adults to understand a world in which the environment is being changed by the development of new technology including new chemicals and substances? To what extent can educators and applicators make pesticides application safer, more effective and precise, and more economic than they are today?".

One of the most important factors associated with solving the problems of participants in adult education programs, especially in pesticide training programs, is that the level of cognition for the instruction is often ignored.
Cognitive researchers (Thomas and Anderson, 1991) suggested that the design of adult educational programs should include consideration of the levels of cognition.

**Rationale for the Study**

Adult educators have recently given greater attention to developing programs, courses, and instruction to meet the special needs of adults. Major emphases have been on getting adults into the educational system, have been largely of credit or noncredit group instruction and have been offered by industry, and community agencies as well as by schools and colleges (Cross, 1978).

The continuous increase in agricultural technology required that data be obtained to restructure adult educational programs, the key to economic development for a high tech society. The development of new technology also required that basics should be defined to include the cognitive level needed for all adults for the century ahead. Henderson (1988) indicated that one of the problems that Extension must resolve in order to carry out a viable educational mission in the years ahead is the inadequate knowledge base on which some extension programs are conducted. He suggested that Extension should teach its clientele how to further develop, use, and improve their cognitive skills in order to become better thinkers. High
cognition levels imply thinking, problem solving and decision making abilities.

The recognition that pesticides pose risks to human health and the environment are salient reasons for the government and industry to undertake training programs to minimize these risks (Ragsdale et al., 1987). Farmers and ranchers are trained for pesticide application by the Ohio Cooperative Extension Service (OCES) under joint agreement among ODA, EPA, and USDA. Through agreement between the ODA and the OCES, a training program for applicators is the responsibility of the OCES. In 1977, the Ohio Plan for certification of Pesticide Applicators was approved. The OCES has conducted and continues to conduct an extensive program of training for private applicators that assures each competent applicator the ability to purchase and use restricted pesticides required in the agricultural operation. Each private applicator was initially trained in the core (basic and essential information common to all pesticide use operations) elements of pesticide application and in specific knowledge related to the restricted pesticide that he/she will need to protect livestock and crops. More comprehensive training of private applicators is provided through programs of continuing education. These programs enable participants to obtain a higher level of understanding and to acquaint themselves with newer materials, up-dated recommendations,
changes in regulations and expanded pesticide usage.

Content in the core program provides education in:

1. Recognition of common pests encountered in the particular farm operation.
2. Understanding the principles and recommendations for pest management and control related to the farming operation.
3. Familiarity with and understanding of labeling.
4. Understanding the principles of correct application.
5. Recognition of poisoning symptoms and the procedure for medical aid.
6. Procedures for storage and disposal.
7. Personal protection.
8. Recognition of local environmental situations.
9. Legal responsibilities.

Table 1 describes the total number of private applicators holding a valid Ohio certification for 1987-90.
Table 1.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of applicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>16,702</td>
</tr>
<tr>
<td>1988</td>
<td>17,830</td>
</tr>
<tr>
<td>1989</td>
<td>18,665</td>
</tr>
<tr>
<td>1990</td>
<td>18,523</td>
</tr>
<tr>
<td>1992</td>
<td>19,865</td>
</tr>
</tbody>
</table>


Table 2.

Certification Training in Ohio as of Mid-Year 1991

<table>
<thead>
<tr>
<th>Program Activity</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training Session Monitored by ODA</td>
<td>158</td>
</tr>
<tr>
<td>Applicators Certified</td>
<td>391</td>
</tr>
<tr>
<td>Applicators Recertified</td>
<td>1,729</td>
</tr>
<tr>
<td>Total Applicators</td>
<td>19,365</td>
</tr>
</tbody>
</table>

Table 2 provides a summary of the program and mid-year accomplishments for private applicators training programs for FY 1991.

Annually, the Ohio Department of Agriculture, Pesticide Regulation Section, receives thousands of telephone calls concerning complaints about pesticides. Most of these calls involve human illness, allegations of property damage or misuse of the pesticide (Allen, 1991). Table 3 shows the yearly investigations made by the ODA Pesticide Regulation Section on suspected pesticide use problems between 1984 and October 18, 1991.
Table 3.


<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>370</td>
</tr>
<tr>
<td>1985</td>
<td>442</td>
</tr>
<tr>
<td>1986</td>
<td>473</td>
</tr>
<tr>
<td>1987</td>
<td>487</td>
</tr>
<tr>
<td>1988</td>
<td>285</td>
</tr>
<tr>
<td>1989</td>
<td>270</td>
</tr>
<tr>
<td>1990</td>
<td>303</td>
</tr>
<tr>
<td>1991</td>
<td>319</td>
</tr>
<tr>
<td>1992</td>
<td>331</td>
</tr>
</tbody>
</table>

Table 4 shows the type and number of reports for agriculture investigated by ODA Pesticide Use Investigations Section in 1991.
Table 4

<table>
<thead>
<tr>
<th>Type of Report</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicide Drift</td>
<td>37</td>
</tr>
<tr>
<td>Fish Kill</td>
<td>9</td>
</tr>
<tr>
<td>Crop Damage</td>
<td>8</td>
</tr>
<tr>
<td>Facility Spill</td>
<td>6</td>
</tr>
<tr>
<td>Facility Runoff</td>
<td>3</td>
</tr>
<tr>
<td>Improper Disposal</td>
<td>3</td>
</tr>
<tr>
<td>Human Illness</td>
<td>3</td>
</tr>
<tr>
<td>Bird Kill</td>
<td>2</td>
</tr>
<tr>
<td>Field Runoff</td>
<td>1</td>
</tr>
<tr>
<td>Abandoned Facility Pollution</td>
<td>1</td>
</tr>
<tr>
<td>Herbicide Effectiveness</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>74</strong></td>
</tr>
</tbody>
</table>

Note: The numbers shown here reflected the actual number and type of complaints investigated. The reports did not specify in which of these cases the allegations were found to be justified.

Table 5 shows the type and number of reports for agriculture investigated by ODA Pesticide Use Investigation Section in 1992.
<table>
<thead>
<tr>
<th>Type of Report</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drift</td>
<td>37</td>
</tr>
<tr>
<td>Spill</td>
<td>8</td>
</tr>
<tr>
<td>Improper Disposal</td>
<td>3</td>
</tr>
<tr>
<td>Worker Exposure</td>
<td>2</td>
</tr>
<tr>
<td>Product Cross Contamination</td>
<td>2</td>
</tr>
<tr>
<td>Illegal Recommendation</td>
<td>1</td>
</tr>
<tr>
<td>Chemical Odor</td>
<td>1</td>
</tr>
<tr>
<td>Livestock Poisoning</td>
<td>1</td>
</tr>
<tr>
<td>Run Off</td>
<td>1</td>
</tr>
<tr>
<td>Improper Storage</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
</tr>
</tbody>
</table>

Matt Beal of ODA on February 20, 1992, revealed that during the previous fiscal year, in Ohio, field notices of warning to pesticide applicators were 688. Department notices of warning were 132 in number, criminal actions referred were 26, administrative hearing conducted was 5, and stop sales were 8.
However, the fact is that, after more than 15 years of PAT program in Ohio, several cases of poisoning, warnings, and criminal actions occur annually. This illustrates that the goals of prevention have not been achieved as might have been expected. This study should provide a stronger theoretical and empirical bases for achieving the objectives of the training program.

Thomas and Anderson (1991) indicated that interest in applying cognitive theory to instruction was reflected in the surge of research in the 1980's that sought to apply cognitive theory to teaching and learning in several areas of school curriculum, especially math, science, and reading. Although several research studies have been conducted on adult cognition (Aja, 1988), none has been conducted in the field of pesticide applicator educational programs. The problems faced by pesticide applicators suggest that higher level cognition is also relevant to pesticide applicator training programs. Because they must be decision makers and problem solvers.

Since the cognitive domain is critical to the development of learning situations through which adult students interact, and since a measure of precision is needed to specify carefully this important phase of curriculum building (Bloom, 1965), the pesticide training program is one setting in which to examine how and at what level adults
learn and are taught.

Ismail (1992) recommended that a study be conducted to assess the achievement of the participants in a particular program conducted by OCES county agricultural agents. The study could examine the levels of cognition at which test items were written and levels of cognition which participants achieved.

Problem Statement

The widespread use of pesticides has resulted in problems involving human health, adverse effects on nontarget organisms, and environmental contamination of air, soil and water (Moody, 1990). Public concern over the amounts of pesticides that are being applied to the land, and their possible side-effects on human and animal health has risen. Many of these problems, however, result from the improper use, handling, or storage of pesticides. There have been and continue to be unfortunate and generally inexcusable incidents where workers become grossly exposed to pesticides due to improper and inadequate industrial hygiene or carelessness in handling and use. Consumers have been inadvertently poisoned by pesticides spilled carelessly during transportation in conjunction with food products. The cases are solely due to the irresponsibility of the users or handlers (Bohmont, 1990).
Farmers are seeking ways to improve their production efficiency by wise use of pesticide. The challenge to the United States agricultural educators, including the Cooperative Extension service (CES), is how to respond to the complex changes and widespread use of pesticides in order to provide participants in pesticide applicator training programs with adequate and comprehensive instruction in the safe use of pesticides through expansion or improvement of pesticide applicator educational programs (National Task Force, 1988).

Pesticide curriculum developers must decide what level of cognitive development will be necessary for applicators to master the content for a given unit of study in the pesticide training course in order to protect people and the environment. More effort should be expended on delivering knowledge that helps participants in the pesticide applicator program develop higher cognitive levels so that they will become problem solvers and decision makers.

**Purpose of the Study**

The purpose of the study is to determine the achievement of the participants in the Ohio private pesticide training instruction program by assessing the cognition levels achieved by the participants in the training program.
Objectives of the Study

The following objectives were developed to guide the study:

1. Determine the attitude of participants toward information given through the PAT program.
2. Determine the attitude of participants toward the PAT program.
3. Determine the attitude of participants toward the methods of instruction used in the PAT program.
4. Determine selected demographic characteristics of participants in the PAT program.
5. Determine the intended cognitive levels of instruction in the PAT program.
6. Determine the prior knowledge of participants in the core area.
7. Determine the actual cognitive levels reached by participants in the core area.
8. Determine the learning (achievement) of participants in the core area.
9. Determine significant differences in prior knowledge between the groups of participants by county.
10. Determine significant differences in actual levels of cognition achieved by the groups participants by county.
11. Determine significant differences in prior knowledge and the actual level of cognition of participants by county.

12. Determine significant difference between prior knowledge and actual level of cognition of all participants.

13. Determine the relationship between the learning of the participants and the independent variables.

14. Determine the relationship among the intended levels of cognition of instruction and the prior knowledge of participants.

15. Determine the relationship among the cognition achieved by the participants and prior knowledge of participants.

16. Determine how intended cognition levels of instruction vary with the attitudes and selected demographic variables.

17. Determine how actual cognition levels achieved by the participants vary with the attitudes and selected demographic variables.

18. Determine how the learning of the participants varies with the attitudes and selected demographic variables.

Significance of the Study

Before major objectives in the PAT program can be more effectively and fully achieved, an investigation of the
current state of learning by participants appears warranted. The cognitive level of instruction affects how much adult students learn. If it is found that the program is not carrying them to higher levels of cognition, the result and findings would be expected to be of particular importance to the curriculum planners and teachers in the pesticide training and certification program.

The study will be helpful to the OCES and ODA by describing the intended and actual cognition levels of instruction. It will also be helpful to OCES and ODA by describing the learning achievement of farmers participating in the training program. This study may raise the consciousness of educators and developers of curriculum materials so they may offer more cognitively balanced training materials. The findings may be important to advisory groups in reviewing proposed educational programs for content and instructional quality and proposing modifications in programs and developing new educational programs. Extension administrators may utilize the findings to ensure that extension training programs deliver their charge to educate rather than simply transfer basic facts to obtain a certificate.

Participants may benefit from the findings by knowing their levels of achievement in the program in which they are participating. This awareness of achievement may rouse their
enthusiasm and provide a needed challenge to develop higher levels of cognitive abilities if lower levels were in the program. If the researcher finds that the information given through the pesticide education program is at appropriate levels of cognition, a study of this type may be the bases for upgrading education in the use of pesticide. If this study is replicated in other states, the findings will facilitate state reciprocity in accepting each other's training programs or certificates. Those involved in the program may also be better able to respond to charges by critics that participants are not learning adequately even though they obtain the certificate.

Definition of Terms.
The following variables were defined: achievement, actual level of cognition, age, attitude, effectiveness, dependency on agriculture, intended level of cognition, level of education, attitude toward the program, attitude toward methods of instruction and prior knowledge of students in the core topics taught in the pesticide training program. Achievement. For a PAT program, achievement was an individual participant's learning related to a particular topic in the core. The operational definition was the mean percentage posttest score minus the mean percentage pretest score on cognitive tests designed to measure the perceived
level of achievement through participation in the training program.

**Actual Level of Cognition.** Actual level of cognition was defined as a mental process: knowing and retaining information, making judgement or evaluation. Actual level of cognition was operationally defined as the achieved level of cognition (mean percentage posttest score) from the scores of participants in the posttest instrument designed to measure their learning in the core area.

**Age.** Age was the number of years since birth as self-reported by an individual participant.

**Attitude.** Attitude was constitutively defined as a particular feeling about something in a certain way resulting in acceptance or rejection. Attitude, therefore, involves a tendency to behave in a certain way in a situation which involve that something, whether person, idea or object. It is partially rational and partially emotional and is acquired, not inherited in an individual (Foster, 1961). Operationally, attitude was defined as the mean score of participants on Likert-type scaled items designed to measure their predisposition toward (the information given and others) in the training program.

**Attitude toward Information Given.** Constitutively, this term was defined as action in response to the pesticide training program. Operationally, attitude was the responses of
participants on Likert-type scaled items designed to measure interest in and level of acceptance of the information given through the training program such as content of each CORE, acceptability of the teacher, time and location as self-reported by an individual participant.

**Attitude toward Methods Of Instruction Used.** Operationally, this construct was defined as the responses of participants on a seven point Likert-type scale designed to measure the attitude of participants toward the delivery methods used in the pesticide training program.

**Dependency on Agriculture.** Dependency on agriculture was constitutively defined as the self-reported percentage of time devoted to farming. Operationally, dependency on agriculture was defined as the number of days devoted to farming in the past twelve months as self-reported by an individual participant.

**Intended Level of Cognition.** Intended Level of Cognition is operationally defined as the level of cognitive instruction desired by the teacher to be achieved in the pesticide training program.
Level of Education. This variable was constitutively defined as the highest level of education completed by an individual. For the purpose of this study, level of education was operationally defined as the highest level of formal education as self-reported by an individual participant in the pesticide training program.
Chapter II

LITERATURE REVIEW

The review of literature for the study was conducted to determine the knowledge base related to the achievement and the levels of cognition on pesticide training for private applicators in the Ohio pesticide training program. The literature review was conducted in three areas of adult education: (1) philosophy and goals of Extension, (2) cognition and adult learning and (3) what information existed to determine the achievement, and intended, and actual levels of cognition of participants in the pesticide training program.

Extension Mission and Goals.

Literature related to the mission of the Cooperative Extension Service revealed that the national and state mission for the Cooperative Extension Service was to provide research based education to improve the quality of life and the economic stability of individuals, families, and communities (NASULGC Committee, 1983; Moser, 1989; Prawl et. al., 1984; Norland, et al., 1990).

The Cooperative Extension System (CES) is a public funded, nonformal, educational system that links the education and research resources and activities of the U.S. Department of Agriculture (USDA), 74 Land-Grant Universities, and 3,150 county administrative units. As its stated mission, the Cooperative Extension System helps people improve their lives through an educational process that uses scientific knowledge focused on issues and needs.

Norland et al. (1990) postulated that the goal of the Cooperative Extension Service, as one of the world's largest adult education organizations, could be to:

"Promote a major, continuing mode of adult behavior aimed at self-directed growth using organized and sequential learning experience designed to meet the needs of adults. Incorporated into these experiences is the opportunity for adults to understand themselves in relationship to their immediate world as well as to the extended, acquiring new skills and powers to not only function but flourish.

Inherent in this goal of the extension mission is the assumption that Extension educators know and understand how to accomplish this goal; that they possess the knowledge and skills needed to anticipate and recognize adult needs and direct learning activities to adequately address those needs (Norland et.al., 1990).

Ohio's Mission

The mission of Ohio Cooperative Extension Service is "to help people improve their lives through an educational
Within the context of the mission and goals of the Cooperative Extension System (CES), the federal Extension Service (ES-USDA) designated several programmatic goals for continuous and concentrated attention throughout the CES. Among these are:

To strengthen the family and home through the attainment of knowledge, human skills and technology needed for creating a satisfying quality of life with wise use of available pesticide by private applicators.

To cooperate with agencies and institutions of federal, state, and local governments and the private sectors in developing and conducting informal education programs for private applicators.

Ohio State University Extension Mission

The mission of the Ohio State University Extension is "To help people improve their lives through an educational process using scientific knowledge focused on identified issues and needs".

To address these broad national and state goals as appropriate to the needs of clientele in the state of Ohio, the OCES has organized and continues to organize pesticide training programs for private applicators.

Rivera (1987) reported that the CES has been unique in its informal dissemination of research-based facts from USDA's Agricultural Research Services, the cooperative state
research service, other universities in the land-grant system, and leading institutions throughout the United States. State specialists have been responsible for disseminating available information about home economics, community and rural development and 4-H youth programs. They keep a steady flow of reputable information flowing to county extension offices for transmittal to appropriate local audiences.

The ODA, OCES, specialists, and county agents have played vital roles in program support. The materials which they develop have been used by many others. The handbooks and popular publications prepared by specialists and county agents on wise use of pesticides and pesticide application for training of private applicators have been used by thousands of clientele and many researchers (Hall et al., 1991).

**Adult Education and Level of Cognition**

A review of literature related to adult education and cognition revealed that adult education is moving from an emphasis on technology transfer to a focus on adult learning and cognition. In recent years, researches related to cognition levels, cognitive styles and cognitive structures have provided some insight into adult learning ability and achievement (Bruner, 1968; Cropleg, 1977; Dumazedier, 1972; Kidds, 1972; Thomas and Anderson 1991). Cropleg (1977)
stated that adopting a system of lifelong education which functions as the basis for acquisition of skills of a new type has been found to be economically rewarding for a society. Of further importance to adults were improved quality of life, greater self-fulfillment or liberation from ignorance, poverty or exploitation, and certification as required by law. He further emphasized that adult education has served as the basis for a modern economy which has led to a higher standard of living.

Adult learning has essentially been an attempt by the participants to satisfy their needs as they perceive them (Kidd, 1965). He emphasized that learning happens readily when adults perceive their needs are satisfied by certain courses of action. However, learning can equally happen when the person is not interested or aware of what is to be learned. The adult student may not know in advance how fascinating or difficult a particular study may be. But effective learning depends upon learners being fully engaged and how important the persons believe the expected knowledge is in terms of their own development.

Barton et al. (1960) and Knowles (1990) emphasized that the desire and motivation to learn are essential to achieving effective learning and especially with participating adults who are typically under no compulsion to attend classes or to prepare assignments. The desire to learn may come from a
deep feeling of need for some new knowledge or skill to meet a perplexing problem, or be required by law for certification or license. Knowles (1990) observed that adults are motivated to learn as they experience needs and interests which learning will satisfy; therefore, needs and interests are appropriate starting points for organizing adult education programs.

The majority of educational objectives for instructional programs cluster in the cognitive versus the psychomotor or the affective domains (Jessen et al. 1961; Verduin, 1980). The cognitive domain is generally viewed as a category labeled "knowledge", and the major components of the cognitive domain are knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956). Since a hierarchy does exist in the cognitive domain, an adult learner cannot apply or analyze concepts until the knowledge and comprehension of the subject matter are assured. The same holds true for all categories within the cognitive domain. Bloom (1965) and Knowles (1990) outlined and explained the cognitive domain as follows:

1. **Knowledge**

   Knowledge involves the recall of the specific and the universal, the recall of methods and processes, or the recall of pattern, structure, or setting. It is the lowest level in the cognitive domain.
(a) Knowledge of specifics: knowledge of terminology and knowledge of specific facts. It is the recall of specific and isolated bits of information.
(b) Knowledge of ways and means of dealing with specifics: knowledge of conventions, trends and sequences, knowledge of criteria, and methodology. This is knowledge of the ways of studying, organizing, judging, and criticizing.
(c) Knowledge of the universal and abstractions in a field. This the knowledge of the major schemes and patterns by which phenomena and ideas are organized.

2. **Comprehension**

This is a kind of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

(a) Translation. Comprehension as evidenced by the care and accuracy with which the communication is paraphrased or rendered from one language or communication to another.
(b) Interpretation. This is the explanation or summarization of a communication.
(c) Extrapolation. This is the extension of trends and tendencies beyond the given data to determine
implications, consequences, corollaries, effects, etc.,
which are in accordance with the conditions described in
the original communication.

3 Application

This is the level that involves the use of abstractions
in particular and concrete situations. The abstraction may
be in the form of general ideas, rules of procedure, or
generalized methods.

4. Analysis

This level is concerned with the breakdown of a
communication into its constituent elements or parts.

(a) Analysis of elements. This is the identification
of the elements included in a communication.

(b) Analysis of relationships. This is the connections
between elements and parts of a communication.

(c) Analysis of organizational principles. The
organization, systematic arrangements, and structure
which holds the communication together.

5. Synthesis

This level focuses on the putting together of parts to
form a whole.

(a) Production of a unique communication. This is the
development of a communication which the writer or
speaker attempts to convey, such as ideas, feelings,
and/or experiences to others.

(b) Production of a plan or proposed set of operations. The development of a plan or the proposal of a plan of operation.

(c) Derivation of a set of abstracts relations. This is the development of a set of abstract relations either to classify or explain particular data or phenomena, or the deduction of propositions and relations from a set of basic propositions or symbolic representations.

6. Evaluation

This is the judgement level about the value of a material and methods for given purposes.

Thus, each component or level of cognition is dependent on one(s) lower than it. This is important to understand if adult educators wish to incorporate higher order cognitive tasks in the learning experiences of their students.

Numerous criticisms of Bloom's taxonomy have resulted in several adaptations and developments to meet particular needs of their authors. For example, Newcomb-Trefz (1987) modified Bloom's Taxonomy into four categories: remembering, processing, creating, and evaluation. They combined comprehension, application, and analysis into processing. They developed the modified version of Bloom's Taxonomy for use with the College of Agriculture at The Ohio State University. The modified version was successfully used with
the subjects from agriculture. This study used the Newcomb-Trefz model since this model represented Bloom's Taxonomy in a way that is more readily understood. Figure 1 presents a comparison of the two models.

Knowledge level in Bloom's taxonomy was retained but was renamed remembering in the Newcomb-Trefz model to describe more accurately the type of behavior required to function at this level. Questions used at this level involve the recall of knowledge.

Bloom's comprehension, application, and analysis levels of cognition were combined to form processing level. Processing level questions.

Synthesis level in Bloom's taxonomy remained intact but was renamed creating in Newcomb-Trefz model to more accurately reflect the behavior required of activity at that level.

The level of evaluation from Bloom's taxonomy was retained but renamed evaluating. Evaluating level question. A complete list of the characteristics of questions, vocabulary of Newcomb-Trefz (1987) model are presented in Appendix A, B, and C, respectively.
Bruner (1968) and Cropleg (1977) reported that cognition level is a highly interlocking process. Each level is connected to earlier levels, in that it arises out of them. On the other hand, each level is also connected to later levels, in that a preceding level provides the basis for later levels. Learning was rightly viewed as a continuous fabric stretching over a life time and it is dependent on experience. Learning has been found as something which, to a certain extent, people construct for themselves. Dumazedier (1972) observed that the key cognitive skill fostered by a lifelong education-oriented curriculum would involve applying innovative knowledge. What was important was understanding
and using information (turning it into knowledge).

Kidds (1972) noted that students will learn to know through analysis of the tactics and codes of knowledge, rather than through the acquisition of specific bits of information. Kidds advocated the development of adult education curriculum which should be based on fostering productive thinking by providing a level of cognition required for a particular educational program. Adult educators should then serve simply to provide the concrete instructional materials upon which productive or creative thinking would act. Such a curriculum would foster a grasp of patterns and forms of knowledge, so that learning would serve as a basis for the acquisition of new skill.

Thomas and Anderson (1991) indicated that the capacity to transfer knowledge is of particular importance in a rapidly changing context. Transfer concerns the capacity to: (a) see as relevant in a new context something that was learned in a different context, (b) applying what has been learned in another context to a new context, and (c) apply old knowledge in a new context that is sufficient novel to require learning of new knowledge. Transfer can mean applying knowledge across discipline, from classroom to real world, or from one task to another in the same area of practice. If the objectives of the pesticide applicator training program are to improve the knowledge and attitudes
of participants, the use of safe, environmental sound pesticide practices by participants, and the transfer of the knowledge and skills gained through the pesticide applicator training program to their farming technics, instructional design that develops higher level cognition is necessary.

Cognitive researchers (Jones, no date and Ausubel, 1972) have stressed that instruction should enable students to construct meaning from what they learn. Jones noted that some of the conditions that promote the construction of meaning are: when students are able to link new information to prior knowledge; when students connect to real-world tasks and issues that are challenging and interesting; and when students actively engage within the context, questioning its premises and applying it to new examples and situations.

Ausubel (1972) indicated that the principal factor influencing adult learning and retention of meaningful new material was an individual's organization, stability and clarity of knowledge in a particular subject matter field at any given time. A clear, stable, and suitably organized structure facilitated the learning and retention of new subject matter. Unstable, ambiguous, disorganized or chaotically organized cognitive structure inhibits learning and retention. Hence, it was largely by strengthening relevant aspects of cognitive structure that new learning and retention could be facilitated.
McKeachie (1986) indicated that students with strong desires to achieve would be motivated to learn and attain at a high cognitive level in a situation in which they perceived their chances of success as about fifty-fifty. Since a certificate is important to the private pesticide applicator, participants in the training program will learn whatever is necessary to obtain the certificate. If instructors base the success in the examination on memorization of details, participants will memorize the text. If participants believe success is based on their ability to integrate and apply principles, they will attempt to do this. McKeachie warned that grades or certificates should not be separated from the kind of learning and cognition desired. Using a grade or certificate chiefly as a threat may produce avoidance rather than interest.

**Studies of Intended and Actual Level of Cognition.**

Ismail (1992) assessed the intended levels of cognition in OCES county agricultural agents'/state agricultural specialists' programs. His findings revealed that county agents tended to plan to deliver the programs at lower levels of cognition (remembering level).

Cano (1988) assessed the intended level of cognition of instruction of production agriculture teachers in the public secondary schools in Ohio. He found that most of the instructional objectives were written at the lower
remembering and processing levels of cognition.

Whittington (1991) studied the aspired and assessed levels of cognition of instruction of College of Agriculture professors at The Ohio State University using the Newcomb-Trefz model. She found that seventy percent of the professors aspired to have approximately 70% of their discourse at the remembering level, and aspired to write 75% of their test items at the remembering and processing levels.

Bhardwaj (1989) studied the intended cognition level of educational programs offered by OCES county agricultural agents. His findings revealed that county agents planned programs at lower levels of cognition (remembering and processing).

**Actual Level of Cognition**

Ismail (1992) indicated that 60% of the county agricultural agents actually delivered OCES programs at the comprehension and application levels. All state agricultural specialists actually delivered some of the content for the OCES programs at the analysis, synthesis or evaluation levels of cognition.

Whittington (1991) found that the assessed discourse for participants was approximately 93% at the remembering and processing levels. Approximately 80% of the test items were found to be at the remembering and processing levels. Forty-five percent of the quizzes were assessed at the creating
levels, and approximately 75% of students assignments were judged to be at the processing or creating levels. A majority of the professors wrote their test items at the remembering level.

Almost every learning theory has emphasized the powerful effect that prior related knowledge learning has upon current learning and cognition (Wang et al., 1985; Briggs and Collis, 1982; Thomas and Englund, 1990; Evans, 1987). Prior knowledge in an educational program for adults has been found to be associated with success and failure of an educational program. Wang et al. (1985) emphasized that prior knowledge in an educational program should serve as important basis for improving educational practices. To avoid program failure, the extension educator should conduct an assessment, formally or informally, of the learners' level of prior knowledge, skills and attitudes before beginning instruction. If it turned out that the learners lacked essential knowledge and skill, the program could be revised to facilitate the development of the skills that were lacking.

Planning educational programs for adults involve certain basic factors that must be given consideration. These include determination of need, identification of goals, arrangement of learning tasks, providing a climate in which adults students are free to utilize their individual prior knowledge, and measurement of learning achievement. Each of
these factors involves various aspects of the adult as a learner, the principles of learning, and the way in which learning (achievement) can be facilitated (Verner, 1964).

Darkenwald et al. (1982), Petterson et al., (1986,) Foster (1961), McKeachie (1986) indicated that adult learners in general place the most importance on reasons related to achievement, cognitive interests, experience, and professional advancement.

Darkenwald et al. (1982) emphasized the organization of experience within the mind of the learner as a major variable in lifelong learning. Many older people have well developed cognitive strategies that are generally applied to familiar domains to solve their problems. Petterson et al. (1986) emphasized that the coming of an information society offers contradictory trends for late-life learning. Adults' prior knowledge in an educational program has been found to be helpful in coping with the new information environment. Foster (1961) indicated that cognition is essential to adult learners since it is based on learning and thinking (the use of information and facts) as well as including the attitudes, drives and feeling of which beings are capable.

Biggs and Collis (1982) suggested that prior knowledge of an educational program has an effect upon: (a) the learners intentions, both positive and negative, depending on how successful or pleasurable the prior knowledge was, (b)
curriculum analysis, (c) instructional process, and (d) the outcome. They further emphasized that adult curriculum planners should select tasks and content that use what students know and instructors should use methods that draw upon prior knowledge.

Thomas and Englund (1990) indicated that prior knowledge in educational programs influence new learning. Knowledge construction during the learning process in a new educational program reflects and occurs within the previous knowledge. The previous knowledge that adult learners possess and bring with them to an educational program has been established over several years of experience. The established experience explains why it is often difficult to help learners change their views and ways of doing things. Unless learners' educational experience results in construction of a new cognitive organization that integrates, modifies and elaborates the old structure within a new learning one, old structures are likely to continue to guide thinking and actions and new learning is likely to remain inert (Thomas and Englund, 1990).

Evans (1987) indicated that all learning has cognitive, affective and psychomotor dimensions which simultaneously interact on the learning experience. Evans also observed that all new ideas to be learned in an educational program are integrated with prior ideas in that educational program.
Nothing new is ever learned independent of other ideas because new ideas must relate to prior ideas. Sometimes learning is retarded or stopped for negligence of prior ideas in the process of achieving new ideas in an educational program. Some adults, who recognize through prior learning a gap or hole in knowledge, are more motivated to delay the process of learning in order to wait for guidance. Other adults, because prior experience did not provide them either knowledge or ideas about how to process new ideas or the need to learn new ideas, will stop trying to perceive or hold interest in the new ideas. The dependency of new knowledge on old knowledge suggests why teachers' strategies and style should permit a climate in which adult students are free to utilize their individual prior knowledge.

Darkenwald et al. (1982) observed that adequate cognitive feedback, requisite entry level skills and knowledge of an educational program were necessary to achieve the objectives of an educational program. When the desired outcome in terms of either product or process was not entirely clear to the learners, the effectiveness of the learning was limited. Darkenwald et al. (1982), in the same study, also emphasized that learners should have a clear understanding of the desired outcome in terms of their own levels of cognition and achievement so that there would be no question in their minds about the degree to which they were
Lack of feedback has led to the uncertainty of learners about how well they were achieving the learning objectives and, therefore, were unable to take corrective action when it was needed.

Verduin (1980) advocated the need for feedback for adults to enable them to see the achievement of what they have learned and for the instructor to respond to achievement with positive acknowledgement and praise. With achievement and success, a positive pattern of experience would be developed to help students advance to higher levels of cognition.

McKeachie (1986) indicated that teaching effectiveness is the degree to which one has facilitated students achievement of educational objectives, or how well students achieve course goals. He noted that when educators speak of students' learning as the ultimate criterion of teaching effectiveness, they think of the cognitive outcome. These outcomes are assumed to be measured by the final examination for a course. In fact, however, final examinations typically weigh knowledge much more heavily than application, problem solving, or other cognitive objectives. Moreover, since students are strongly motivated for grades/certificates, they will do the best they can to pass the examination regardless of the quality of the teaching they have had. If the teacher has been confusing or not helpful, students often will make
up for the deficiencies by extra studying. Thus, performance of students on final course examinations or professional examinations is not ideal measure of an educational achievement. Nevertheless, using examinations as a measure of cognitive outcome is the best means available to measure the effectiveness of educational programs (McKeachie, 1986) such as a pesticide training program.

Wang et al. (1985) emphasized the use of cognitive level as a measure of the product of an educational program. They observed that learning is a process, not a product, but the measurement of the process presents such major difficulties that educators have followed the practice of measuring the product. Assessment of learning requires that a product be examined to serve as evidence that learning has occurred. Although the learning process is internal and not directly observable, evaluation of the effectiveness of an instructional program has rested upon the measurement of the observable behavior or a product of the desired behavior. Therefore, to determine if a learner has actually achieved a desired educational objective, learners should be required to demonstrate the use of acquired capacity and observed behavior or product as evidence of the achievement. Similarly, it has not been possible to conduct a direct assessment of what a learner understood. Instead, the evaluation process in the cognitive domain has required that
the learner perform or produce a product to demonstrate comprehension of the desired ideas or processes. Because of this situation, specialists in educational evaluation have emphasized the importance of using learning objectives that state specifically what the learner would produce or how the learner would behave at the end of the learning experiences. The product could be oral or written examination which would be a proxy for the expected and actual levels of cognition.

Ladewig and Chickering (1981) investigated education's relationship to learning and adoption behavior of farmers in an educational program. Their findings showed a positive relationship between educational attainment and participation in an educational program. Better educated persons were more knowledgeable about new farming practices. Education prepared one to learn and follow technological information.

A study by Tordoir (1982) revealed that the educational level of the participants in pesticide training programs was a critical element in understanding what was taught and the attainment of a higher level of cognition in the training program. Obviously, most of the printed hazard information on the labels of pesticide containers was of no use to an illiterate worker. Chemical names, symptoms of poisoning, methods of disposal of used containers, etc., were of very little value to illiterate pesticide workers. Understanding of the educational level of participants would be very
important in designing a training program for private pesticide applicators.

Verner (1964) revealed that attitude exerted a profound effect upon the progress of an adult in further learning; however, the effect of attitude on adult learning has been imperfectly understood and inadequately handled by adult educators. Verner further revealed that attitude affected and, to some extent, controlled the actual learning achieved in that it determines the response to material encountered in the learning situation. Verner recommended that adult educators should recognize the impact of the learning situation upon attitude formation in order to avoid those circumstances that may sponsor the creation of a negative attitude toward content or the learning process itself. Attitude formation or change might be an instructional objective, and both the content and the process of educational instruction should be selected with respect to the potential influence in attitude.

In exploring the effect of the Ohio pesticide instruction upon adult cognition and achievement, knowledge about the attitude of participants toward the methods of instruction used was deemed important. The methods of instruction included lectures, video tapes, handbooks and workshops. The techniques and methods used can greatly influence adult learning and achievement. Thus, the attitude
of participants toward the techniques and methods used was expected to be related to adult cognition and achievement.

Differences exist in the characteristics of people who participate in any given adult extension program, including pesticide training. Some participants are full-time farmers and some are part-time farmers whose primary occupation is other than farming. Differing degree of dependency on agriculture could, therefore, affect achievement and cognition levels of participants in a training program (Ladewig and Chickering, 1980).

**Pesticide Hazard**

Studies (Bohmont, 1990; OCES, 1989; Ragsdale, 1986) have indicated that when pesticides were used in a way other than as directed on the label, they were found hazardous to nontarget plants and animals, left harmful residues, and moved from the application site into the surrounding environment.

Bohmont (1990) indicated that pesticides, like automobiles, firearms and medicine, could be and were sometimes harmful when used improperly. Bohmont listed six major areas in the environment where pesticides have been found to be hazardous. These areas were soil, water, air, beneficial insects, plants and wildlife. He observed that an overdose of pesticides that remained for long periods in the
soil limited planting to only a few crops that were not harmed by the chemical.

Ragdale et al. (1987) concluded that human poisoning was clearly the highest price paid for using pesticides. They reported that in many developing countries improper use of pesticides by untrained handlers have often led to poisoning during application. In Central America, about 3,000 to 4,000 pesticide poisoning occur annually. An estimate of about 45,000 total human poisoning occur annually worldwide (Ragdale et al., 1987).

Bohmont (1990) reported that the majority of the established pesticides have no adverse effect on people, animals, or the environment in general when used only in the amount sufficient to control pest organisms. Ragdale et al. (1986) noted that some particular chemicals have been found to produce chronic effects such as increased prevalence rates of cancer, vascular diseases and organic injuries. What implications do these hazardous risks have for the private applicator in Ohio? A law passed by the Congress in 1972 and substantially amended in 1974 and 1978 (called by its initials—FIFRA) regulates the registration, manufacture, transportation, and use of pesticides. The law affected private applicators in many ways. Most importantly, it provided that all pesticides must be used as directed on the label, all pesticides must be classified as "restricted" or
"general", and persons who buy or use restricted use pesticides must be certified as competent pesticide applicator or must be directly supervised by a certified applicator. After October 21, 1977, Ohio law on pesticides required that: No person unless licensed under section 921.06, 921.07, 921.08, or 921.12 of the Revised Code shall apply or directly supervise the application of a "Restricted use pesticide" unless he shall have been certified as a private applicator or unless he is a trained serviceman who is employed by and operate only under the direct supervision of a certified applicator and who carries on only repetitive and routine ground operation. Standards for certification of private applicators shall be set forth in rules adopted in accordance with chapter 119 and section 921.16 of the Revised code.

**Pesticide Liability**

The FIFRA act stated that any applicator using any pesticide as not directed on the label may be fined $5,000.00 if the act proves unintentional or $25,000.00 if done intentionally with the possibility of imprisonment of up to one year. Increases in the number of law suits, and field and department warnings have made private applicator aware of their liability concerning damage to neighbor's property. Damage can be claimed against the applicator who caused off target injury to crop or animals which make the commodity
unsalable. Once damages are settled, if gross misuse is found to be the cause, the applicator can be sentenced to one year imprisonment (Zuchorski, 1976). Pesticide liability suggests that pesticide applicators must maintain a high degree of knowledge to successfully apply restricted pesticides in their farming operations.

**Pesticide Training Program for Private Applicators**

Pesticide training programs for private applicators are expected to upgrade the knowledge of pesticide users across the country so they can better deal with pest control problems and minimize possible risks to themselves and others, and avoid environmental hazards, such as pollution of water ways or wildlife areas (USDA Extension Service, 1977).

In the state of Ohio, a group of professionals, which included the Ohio Cooperative Extension Services (OCES), ODA staff, and state specialists, have been responsible for designing, delivering, and conducting pesticide applicator training programs at the local level. Each private applicator is initially trained in the CORE (basic and essential information common to all pesticide use operation) elements of pesticide application and in specific knowledge related to the restricted pesticide that would need to protect principle crops. A five hour training session is provided. In addition, a manual was prepared by the OCES that could be used for self-study or in combination with an
educational program conducted for private pesticide applicators. The manual was developed to assist private applicators to be better prepared for taking the examination that is essential to become a certified applicator (Hall et al., 1991).

As pesticide applicators face the problems of law suits, suspension or cancellation of certificates due to improper use of pesticides, they are challenged to apply their knowledge in new ways, to acquire new knowledge through participation in pesticide training program and to engage in higher cognition levels. The surest way of preventing accidents, warnings and criminal actions against private as well as commercial applicators is by educating them at all stages from manufacture to final use. ODA and OCES have been effective in developing and conducting training programs for pesticide applicators.

If the objectives of the pesticide applicator training program are to improve the knowledge and attitudes of participants, the use of safe, environmental sound pesticide practices by participants, and the transfer of the knowledge and skills gained through the pesticide applicator training program to their farming enterprises; instructional programs that develop higher levels of decision making and problem solving are necessary.
Chapter III

METHODOLOGY

The purpose of this study was to determine the learning of the participants in the Ohio private pesticide applicator training program by assessing the intended level of cognition of instruction and the actual cognition level of the participants in the training program. This chapter discussed the research design, the population and subject selection, instrumentation, data collection, and data analysis procedures utilized.

Design

Four instruments: pretest, posttest, interview schedule, and attitude and demographic were utilized to obtain data that was used to investigate the following research objectives:

1. Determine the attitude of participants toward information given through the PAT program.
2. Determine the attitudes of participants toward the PAT program.
3. Determine the attitude of participants toward the methods of instruction used in the PAT program.
4. Determine the selected demographic characteristics of participants in the PAT program.
5. Determine the intended cognitive levels of instruction in the PAT program.

6. Determine the prior knowledge of participants in the core area.

7. Determine the actual cognitive levels reached by participants in the core area.

8. Determine the learning (achievement) of participants in the core area.

9. Determine significant differences in prior knowledge between the groups of participants by county.

10. Determine significant differences in actual levels of cognition achieved by the groups of participants by county.

11. Determine significant difference between prior knowledge and the actual level of cognition of participants by county.

12. Determine significant difference between prior knowledge and actual level of cognition of all participants.

13. Determine the relationship between the learning of the participants and the independent variables.

14. Determine the relationship among the intended levels of cognition of instruction and the prior knowledge of students.
15. Determine the relationship among the cognition achieved by the participants and prior knowledge of participants.

16. Determine how intended cognition levels of instruction vary with attitudes and selected demographic variables.

17. Determine how actual cognition levels achieved by the students vary with attitude and selected demographic variables.

18. Determine how the learning of the students vary with attitudes and selected demographic variables.

A descriptive ex post facto design identified by Campbell and Stanley (1963) was employed for the design of the study. The study can not be considered a true experimental design because subjects who participated in the pesticide PAT program self-selected by enrolling in the PAT program. Moreover, the variables were not manipulated but were already naturally occurring or self-selected by the subjects. Figure 2 is a model of the main independent variables, the dependent variables and the rival or alternative variables to be investigated.
All the participants were pretested at the beginning of the training and posttested after they completed the training program. The pretest and posttest design of the study would provide evidence that the program was effective and that participants learned through participation. Care was given to ensure that all the topics provided in the core were covered in the exam. Demographic data were collected to determine the background of the participants.
In conducting ex post facto research, the investigator has no power to manipulate the independent variables. Therefore, in this study, establishing cause and effect was possible. Because of the inability of the investigator to use randomization to control rival variables in ex post facto research, the investigator followed the advice of Kerlinger (1973) and McCracken (1991) to control rival variables. The potential rival variables were built into the study. The potential rival variables were identified as attitude toward the information given, attitude toward the program, attitude toward methods of instruction, level of education, age, and dependence on agriculture.

In this study, possible threats to validity were: (1) population generalizability, and (2) non-response error. A random sample was not possible because of the number of counties that accepted to participate in the study. In this study, non-response error might have occurred in two ways. Firstly, if a participant for the study did not take the pretest exam but took the posttest exam. Secondly, if a participant did not answer all the questions in both pretest and posttest exams. Non-response error was controlled by requesting the participants to answer all the questions. Even when they were not sure of the correct answer to a question, they should circle the answer that best answers the question. There was no penalty for guessing. Participants
were given enough time to complete the exams and attitude questions. All those who took the posttest took the pretest. Just as a large sample would be more reliable than a small sample, a high response rate would produce a better and less biased sample than one with a larger non-response rate (Fowler, 1988). There was a 100% response rate.

Population and sample

The target population for this study consisted of the participants in the 1992/93 Ohio PAT program. The accessible population for this study consisted of all the participants in seven counties of Ohio who self-selected to participate in the study (Appendix A). Counties that did not participate in this study had either previously conducted their training or chose not to participate in the study. Accordingly, a purposeful sample of counties and participants was used for the study.

Instrumentation

The pretest and posttest questions used in this study for measuring the effect of the training and instruction on achievement at the remembering level of cognition of participants were adapted from Hall et al. (1991) and EPA Home Study Course (1980) and modified to suit this study. The pre- and posttest questions used in this study for
measuring the effect of the training and instruction on achievement at the processing, creating and remembering levels of cognition were developed by the researcher based on the pesticide materials in use in the Ohio PAT program, Bohmont (1990), and information in the core package. The form used for these tests was an objective, multiple choice exam. Two instruments (parallel form) containing different questions, but all measuring the same domains, were used for the study (Appendix B and C). Information in the core package was used to develop the instruments for the study because certification is based on the knowledge of:

1. Recognition of common pests encountered in the particular farming operation.
2. Understanding the principles and recommendations for pest management and control related to the farming operation.
3. Familiarity with and understanding of labeling.
4. Understanding the principles of correct application.
5. Recognition of poisoning symptoms and the procedure for medical aid.
6. Procedures for storage and disposal.
7. Personal protection.
8. Recognition of local environmental situations.
9. Legal responsibilities.
The study used the Newcomb-Trefz model of cognition (Appendix G). The vocabulary and characteristics of questions of the Newcomb-Trefz model (Appendix H and I) were also used to develop the questions used for this study. Seventy-five multiple choice questions: 20 remembering; 20 processing; 20 creating; and 15 evaluating level questions were used for the pilot test.

The researchers deemed multiple choice tests most suitable for use in this study because multiple choice tests provide an extensive sampling of course content; encourage the students to develop a comprehensive knowledge of specific facts; are currently the most highly regarded and widely used form of objective test items; can be used to measure the most important educational outcomes such as knowledge, understanding ability, and recommend appropriate action (Gronlund, 1976). Further, a written examination was used for the study because Cleugh (1970) noted that a majority of adults favored the use of written examination as a true measure of knowledge. Adults felt that a written examination was necessary, that its abolition would adversely affect the status of their qualification. Written examinations provide a comprehensive view of the knowledge of the candidate and provides evidence as to the degree to which a course is fulfilling its purpose, tells if the participants have or have not learned what they have been taught during the
training, and they eliminate those who are unable to learn what was taught in the training.

Prior to the development of the tests, the researcher attended the Ohio pesticide up-date conference organized by the OCES and ODA for Ohio agricultural agents (Appendix J). The objective for attending this conference was to be familiar with the content and terminology used in the PAT program.

Instruments for measuring the attitudes and selected demographic characteristics of the participants were developed by the researcher (Appendix D) and measured:

**Attitude Toward Information Given.** Attitude toward information given was measured by using a Likert-type summated rating scale. A four point rating system of (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly agree was employed.

**Dependency on agriculture.** In this study dependency on agriculture was measured by the self-reported number of days devoted to agriculture in the last 12 months.

**Attitude toward the program.** To measure this variable, a four point Likert-type rating scale of (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly agree was used.

**Attitude toward method of instruction.** A seven point rating scale of not important to very important was used to measure the attitude of participants toward the delivery methods
among a list provided including lecture meeting, video tape, manual, demonstration, and slides/transparences. The higher the rating the more important that method of instruction was to the participant.

Prior and achieved knowledge of students in the core taught.

After the 75 cognition questions and attitude scales were administered to a preliminary group of 21 participants not selected for this study, an item analysis was conducted to identify the best items. Item analysis on an achievement test yields three statistics for each item (1) item discrimination index; (2) number and/or percentage of respondents marking each choice for each item; (3) item mean and standard deviation (Ary et al., 1985). The item discrimination index showed the extent to which each item discriminated among the respondents in the same way as the total score discriminated. If those who have high scores on an item, have high total score and those who have low scores on an item have low total scores, then the item was discriminating in the same way as the total score. The item discrimination index was calculated by a computer that correlated item scores with total scale scores.

Item discrimination correlation coefficients were used to select forty questions used for the study. Two Items with the same or almost the same discrimination coefficients were selected at a time and put into two groups. The
discrimination coefficient in the two groups were equivalent. One group of items was purposefully selected to measure prior knowledge (pretest) and the other used to measure achieved knowledge (posttest) reached in the PAT program (Appendix G).

**Intended Level of Cognition.** The interview schedule (Appendix E) used by Bhardwaj (1989) was used to collect data that was used to measure the intended level of cognition at which the PAT instructors planned to deliver the program (Appendix H).

**Validity.**

To ensure that the tests measure what they were supposed to measure, validity for the instruments was established. Content and face validity were established by a panel of experts (Appendix K). The panel consisted of two experts in cognition research and three technical experts in pesticide application. The initial drafts were given to the panel who were asked to evaluate the instruments for simplicity, clarity, relevance, content and perceived time necessary to complete the examination. Improvement in the instruments were made based on their critiques and recommendations.

**Reliability.**

Reliability assesses whether a test consistently measures whatever it measures. The parallel form technique was used to establish reliability because it is the one that
ODA is currently using to establish reliability of the instruments they use to administer tests for certification. Reliability was further calculated based on pilot test data.

Table 6

<table>
<thead>
<tr>
<th>Cognition level</th>
<th>Before selection</th>
<th>After selection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>Remembering</td>
<td>.65</td>
<td>.70</td>
</tr>
<tr>
<td></td>
<td>.70</td>
<td>.78</td>
</tr>
<tr>
<td>Processing</td>
<td>.81</td>
<td>.85</td>
</tr>
<tr>
<td></td>
<td>.85</td>
<td>.84</td>
</tr>
<tr>
<td>Creating</td>
<td>.79</td>
<td>.80</td>
</tr>
<tr>
<td></td>
<td>.80</td>
<td>.78</td>
</tr>
<tr>
<td>Evaluating</td>
<td>.72</td>
<td>.68</td>
</tr>
<tr>
<td></td>
<td>.68</td>
<td>.81</td>
</tr>
</tbody>
</table>

The reliability coefficients for the cognition levels before and after selecting the 40 questions used for the study were calculated using Cronbach's alpha. The reliability coefficients are reported in Table 6.

L.H. Newcomb, who was a member of the panel of experts and who has conducted research on cognition, rated the 75 questions into different levels of cognition. Sixty-five questions were each rated as a measure of cognition level. The remaining ten questions were either improved or replaced.
Inter-rater reliability between the researcher and Newcomb was 87%.

Reliability for the interview schedule was based on the reliability established by Bhardwaj (1989) and inter-rater between the researcher and P. Squire who had just completed a study on cognition research. Bhardwaj pilot tested the instrument for reliability with selected agricultural agents of the CES not included in the sample for his study. The Cronbach's alpha he obtained was .9 on the data collected from the pilot test. After modifying the interview schedule to suit this study, an inter-rater reliability between the researcher and Squire was .89%.

Bijou, Peterson, and Ault (1968), cited by Bull (1992), recommended that "Unless the sums obtained by each observer are equal, the smaller sum is divided by the larger to obtain a percentage of agreement". The researchers also recommended that reliability might be calculated by scoring each item as agree or disagree match or mismatch and dividing the total by the number of agreements plus the number of disagreements.

Reliability for the attitude instrument was calculated. In order to raise the reliability, one item was deleted from each of the sections. The reliability is reported in Table 7.
Table 7

<table>
<thead>
<tr>
<th>Attitude</th>
<th>Before Deleting</th>
<th>After Deleting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>.79</td>
<td>.82</td>
</tr>
<tr>
<td>Training</td>
<td>.74</td>
<td>.77</td>
</tr>
<tr>
<td>Method</td>
<td>.77</td>
<td>.84</td>
</tr>
</tbody>
</table>

According to Nunnally (1982), an alpha of .5 is the minimum reliability recommended for research purposes.

Data Collection Procedure.

Data for this study were collected between December 1992 and March 1993. The researcher and his adviser made a presentation to the Ohio Extension Agents conducting CORE pesticide training programs to promote their assistance in data. A letter co-signed by the adviser and copied to the Associate Director of the OCES and Ohio State University Extension officials was sent to all county agricultural agents conducting CORE PAT programs (Appendix F). The letter requested their participation in the study. Those who accepted to participate were informed a few days before the
training date of the on-site-visit of the researcher to collect the data. The researcher administered the examinations with the support of the agents. Both pretest and posttest data were collected during the training session. Pretest data were collected at the beginning of the training. Posttest and attitude data were collected after the training. To give the participants the opportunity to answer all the questions, 40 minutes were given to answer the questions. Data for the intended level of cognition were collected from the county agents who conducted the program in the counties surveyed. A face-to-face interview using a tape recorder and an interview schedule was employed to get the responses of the agents.

**Data Analysis.**

Data were analyzed using the Statistical Package for the Social Science PC+ (SPSSx-user's guide, 1985) at The Ohio State University. Descriptive statistics of frequencies, means, standard deviations and percentages were used to determine and describe the attitudes of participants toward information given, toward the pesticide applicator program, toward methods of instruction used, and selected demographic variables of the students. Descriptive statistics were also used to determine the intended level of instruction in the program, the prior knowledge of the students, the actual
level of cognition reached by the students, and the achievement (learning) of students in the training. One-way analysis of variance (ANOVA) was conducted to investigate if there were significance differences between the performance of the groups of participants in the different counties studied. Dependent t-test analyses were conducted to investigate if there were significance differences between the previous knowledge (pretest) and the actual knowledge (posttest) reached by the students in the different counties. The Pearson product moment correlation coefficient and Kendall Tau c were used to determine the magnitude of relationship among achievement and the independent variables. Stepwise multiple regression analyses were conducted to identify important variables predictive of the learning (achievement) of participants, actual, and intended levels of cognition of the participants.
CHAPTER IV

FINDINGS

The following topics were discussed in this chapter: purpose of the study, variables of interest, population and sample, instrumentation, data analysis, and major findings.

Purpose of the study

The purpose of this study was to determine the learning (achievement) of the participants in the Ohio private pesticide applicator program (PAT) by assessing the intended and actual cognition levels of the participants in the training program.

Variables

The following variables were used to guide this study:
1. Dependent variable: The dependent variable for this study was the learning (achievement) of the participants in the PAT program.
2. The main independent variables:
   A. Intended levels of cognition at which the county agricultural agents planned to deliver the program.
   B. The prior knowledge of the participants in the PAT program in the core area.
C. The actual levels of cognition reached by the participants in the PAT program in the core area.

3. **Rival variables:**
   A. Attitude toward the information through the PAT program.
   B. Attitude of the participants toward the PAT program.
   C. Attitude of the participants toward methods of instruction used in the PAT program.
   D. Level of education of the participants.
   E. Age of the participants.
   F. Dependency on agriculture.

The following research objectives were established as a guide for the study:

1. Determine the attitudes of participants toward the information given through the PAT program.
2. Determine the attitudes of participants toward the PAT program.
3. Determine the attitudes of participants toward the methods of instruction used in the PAT program.
4. Determine selected demographic characteristics of participants in the PAT program.
5. Determine the intended cognitive levels of instruction in the PAT program.
6. Determine the prior knowledge of the participants in the core area.
7. Determine the actual cognition levels achieved by participants in the core area.

8. Determine the learning (achievement) of the participants in the core area.

9. Determine the significant differences in prior knowledge between the groups of participants by county.

10. Determine the significant differences in actual levels of cognition achieved by groups of participants by county.

11. Determine the significant differences between prior knowledge and actual level of cognition of participants by county.

12. Determine the significant difference between prior knowledge and actual level of cognition of all the participants.

13. Determine the relationship between the learning of participants and the independent variables.

14. Determine the relationship among the intended levels of cognition of instruction and prior knowledge of participants.

15. Determine the relationship among the cognition achieved by the participants and prior knowledge of the participants.
16. Determine how intended cognition levels of the instruction vary with the attitudes and selected demographic variables.

17. Determine how actual cognition levels achieved by participants vary with the attitudes and selected demographic variables.

18. Determine how the learning of participants vary with attitudes and selected demographic variables.

**Population and sample**

The population was 151 participants in seven counties from Ohio who self-selected to participate in the study.

**Instrumentation**

Two parallel form instruments containing different questions, but all measuring the same domain, were used as pretest and posttest to collect data for the cognition levels of the participants in the core area. An interview schedule was used to collect data regarding the intended levels of instruction. Likert-type summated rating scales were used to measure the attitudes of the participants. Three demographic characteristics of the participants; level of education, age, and dependency on agriculture were selected for this study. Participants were asked to indicate their level of education, age and dependency on agriculture.
Data Analysis

The data were analyzed using the Statistical Package for the Social Sciences PC version (SPSS-PC+) program at The Ohio State University. The statistics utilized included frequencies, means, percentages, standard deviations, one-way analysis of variance, independent t-test, correlation coefficients, and stepwise multiple regression analysis. An alpha level of .05 was set a priori for determining significance relationships between variables.

Major findings

Objective 1: To determine the attitude of participants toward the information given in the PAT program, the participants were asked to indicate their level of agreement on a four point Likert-type scale with thirteen statements related to the information provided through the pesticide training program. Mean ratings on the Likert scale of 3.00 or more indicated that the participants tended to agree with the statement related to the information given in the training program. Mean ratings below 3.00 indicated that the participants tended to disagree with the statement related to the information given in the training program. Table 8 indicated that participants agreed most about picking out important information on a typical pesticide label (3.33),
followed by practicing safety measures to prevent injury to self, others, and the environment (3.29), and understanding the laws regulating pesticides (3.27). The participants disagreed most that their pesticide application practices were fine, they did not need to change (2.28) and that they did not believe that the techniques taught in the pesticide training program were better than the ones they have been using (2.21).
Table 8

Mean and Standard Deviation for Participants' Attitude Toward the Information Given through the PAT program.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MEAN</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correctly identify the pest to be controlled.</td>
<td>3.07</td>
<td>.48</td>
</tr>
<tr>
<td>Control pest effectively on my farm.</td>
<td>3.01</td>
<td>.43</td>
</tr>
<tr>
<td>Choose the correct pesticide formulation.</td>
<td>3.03</td>
<td>.49</td>
</tr>
<tr>
<td>Properly mix pesticides.</td>
<td>3.11</td>
<td>.52</td>
</tr>
<tr>
<td>Pick out important information on a typical pesticide label.</td>
<td>3.33</td>
<td>.50</td>
</tr>
<tr>
<td>Calibrate my application equipment to the distribute the correct amount of pesticide at the correct rate.</td>
<td>3.11</td>
<td>.60</td>
</tr>
<tr>
<td>Distinguish among the toxicity categories of pesticide.</td>
<td>3.21</td>
<td>.49</td>
</tr>
<tr>
<td>Practice safety measures to prevent injury.</td>
<td>3.29</td>
<td>.57</td>
</tr>
<tr>
<td>Properly store leftover pesticides.</td>
<td>3.23</td>
<td>.57</td>
</tr>
<tr>
<td>Properly follow first aid procedures in cases of accident.</td>
<td>3.18</td>
<td>.53</td>
</tr>
<tr>
<td>Understand the laws regulating pesticides.</td>
<td>3.27</td>
<td>.57</td>
</tr>
</tbody>
</table>
"Table 8 (Continued)."

I do not believe that the the techniques taught in the pesticide training program* were better than the ones I have been using. 2.21 .65

My pesticide application practices are fine, and I do not need to change*. 2.28 .67

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.03</td>
</tr>
<tr>
<td></td>
<td>.28</td>
</tr>
</tbody>
</table>

* Negatively worded items were reverse scored.

Objective 2. The participants were asked to indicate their level of agreement on a four point Likert-type scale with twelve statements related attitude toward the PAT program. Mean ratings on the Likert scale of 3.00 or more indicated that the participants tended to agree with the statement related to the training program. Mean ratings below 3.00 indicated that the participants tended to disagree with the statement related to the training program. Table 9 indicated that participants agreed most that the training program should be continued (3.21), and the training program will be very helpful to them.
Table 9.

Mean and Standard Deviation for Participants' Attitude Toward the PAT Program.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MEAN</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am happy to have participated in the pesticide training program.</td>
<td>3.19</td>
<td>.64</td>
</tr>
<tr>
<td>The program held my interest.</td>
<td>2.93</td>
<td>.61</td>
</tr>
<tr>
<td>When the training began I was very interested, but after sometime I became tired and bored*.</td>
<td>2.30</td>
<td>.75</td>
</tr>
<tr>
<td>The training program will be very helpful to me.</td>
<td>3.13</td>
<td>.51</td>
</tr>
<tr>
<td>The training program should be continued.</td>
<td>3.21</td>
<td>.57</td>
</tr>
<tr>
<td>The training program should be improved.</td>
<td>2.93</td>
<td>.75</td>
</tr>
<tr>
<td>The training program was understandable.</td>
<td>3.06</td>
<td>.37</td>
</tr>
<tr>
<td>The training program was well taught by the instructor.</td>
<td>3.08</td>
<td>.37</td>
</tr>
<tr>
<td>&quot;Table 9 (Continued),&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The topics were taught at too high level of understanding*.</td>
<td>2.07</td>
<td>.57</td>
</tr>
<tr>
<td>The facilities for the training program limited participation*.</td>
<td>2.19</td>
<td>.70</td>
</tr>
<tr>
<td>The topics were applicable to the majority of the participants.</td>
<td>3.01</td>
<td>.46</td>
</tr>
<tr>
<td>The courses in the training program were well organized.</td>
<td>3.07</td>
<td>.40</td>
</tr>
</tbody>
</table>

Mean 2.60 .22

*Negatively worded items were reverse scored.
and that they were happy to have participated in the pesticide training program (3.19). The participants disagreed most that the training program held their interest, that the training program should be improved (2.93), and that the facilities for the training program limited participation (2.19)

Objective 3. The participants were asked to indicate their attitude toward six instructional methods that might have been used in the pesticide training program. A seven point Likert-type scale was employed. A value of 5 was assigned to the method rated as very important and a value of 1 was assigned to the method indicated as less important. Table 10 presents a rank order listings of these various methods according to rated importance. The data indicated that the three most important methods of instruction used were Agents guide (5.64), Manual (5.56), and lecture meetings (5.53).
Table 10.

<table>
<thead>
<tr>
<th>Method</th>
<th>MEAN</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agents guide</td>
<td>5.64</td>
<td>1.05</td>
</tr>
<tr>
<td>Manual</td>
<td>5.56</td>
<td>1.11</td>
</tr>
<tr>
<td>Lecture meeting</td>
<td>5.53</td>
<td>1.09</td>
</tr>
<tr>
<td>Slides/Transparences</td>
<td>5.37</td>
<td>1.31</td>
</tr>
<tr>
<td>Video tape</td>
<td>5.37</td>
<td>1.23</td>
</tr>
<tr>
<td>Demonstration</td>
<td>4.80</td>
<td>1.40</td>
</tr>
</tbody>
</table>

Mean 5.38 .82

Objective 4. Three demographic characteristics of the participants selected for this study were: level of education, age, and dependency on agriculture. The participants were asked to indicate their level of education, age, and dependency on agriculture on the instrument used to measure these characteristics. Table 11 revealed that a majority of the participants (66, 43.7%) completed high school or equivalent, 37 participants (24.5%) had some college education, and 29 participants (19.2%) had attended some high school in grades 9-12.
Table 11.

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Freq.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Some grade school (1-8).</td>
<td>4</td>
<td>2.6</td>
</tr>
<tr>
<td>B. Some high school grade (9-12).</td>
<td>29</td>
<td>19.2</td>
</tr>
<tr>
<td>C. Completed high school or equivalent.</td>
<td>66</td>
<td>43.7</td>
</tr>
<tr>
<td>D. Some college.</td>
<td>37</td>
<td>24.5</td>
</tr>
<tr>
<td>E. Completed a four year college.</td>
<td>8</td>
<td>5.3</td>
</tr>
<tr>
<td>F. Completed a graduate or professional degree.</td>
<td>7</td>
<td>4.6</td>
</tr>
</tbody>
</table>

| Mean 3.25 SD 1.1 |

Objective 4 continued. Table 12 showed that a majority of the participants (61 40%) were between the age of 31 and 40, 30 (19.9%) of the participants were between the age of 41 and 50, and 25 (16.6%) were between the age of 21 and 30.
### Table 12.

**Frequency Distribution for Age of Participants in the PAT Program**

<table>
<thead>
<tr>
<th>Item</th>
<th>Freq.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Below 20.</td>
<td>5</td>
<td>2.6</td>
</tr>
<tr>
<td>B. 21-30.</td>
<td>25</td>
<td>16.6</td>
</tr>
<tr>
<td>C. 31-40.</td>
<td>61</td>
<td>40.4</td>
</tr>
<tr>
<td>D. 41-50.</td>
<td>30</td>
<td>19.9</td>
</tr>
<tr>
<td>E. 51-60.</td>
<td>18</td>
<td>11.9</td>
</tr>
<tr>
<td>F. 61-Above.</td>
<td>12</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Objective 4 continued. Table 13 showed that a majority of the participants (45, 29.8%) worked 200 or more days off-farm in the last 12 months. Twenty-eight (18.5%) worked at most 49 days off-farm, while 38 (25.2%) did not work off-farm.
Table 13.

<table>
<thead>
<tr>
<th>Item</th>
<th>Freq.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. None</td>
<td>38</td>
<td>25.2</td>
</tr>
<tr>
<td>B. 1-49</td>
<td>28</td>
<td>18.5</td>
</tr>
<tr>
<td>C. 50-99</td>
<td>20</td>
<td>13.2</td>
</tr>
<tr>
<td>D. 100-149</td>
<td>5</td>
<td>3.3</td>
</tr>
<tr>
<td>E. 150-199</td>
<td>15</td>
<td>9.9</td>
</tr>
<tr>
<td>F. 200-Over.</td>
<td>45</td>
<td>29.8</td>
</tr>
</tbody>
</table>

Objective 5. A face-to-face interview using an interview schedule and a tape recorder were used to collect data used to determine the intended cognition level of instruction. Table 14 showed that the most frequently intended level of instruction was at the remembering level of cognition, followed by the evaluating level.
Table 14

<table>
<thead>
<tr>
<th>Cognition Level</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering (R)</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>Processing (P)</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Creating (C)</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Evaluating (E)</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>R + P</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>R + P + C</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>R + P C + E.</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>100</td>
</tr>
</tbody>
</table>

Objective 6. Twenty questions were used to collect data regarding the prior knowledge (pretest) of the participants in the CORE area and twenty questions was used to collect data regarding the actual level of cognition (posttest) by participants in the PAT program. Five questions were in each cognition level. Each question carried 1 point. Five points could have been scored by a participant that answered all the questions in each cognition level correct. A total of 755 points could have been scored by the 151 participants if
they answered all questions correct in each cognition level. The highest score 555 points (74%) on the pretest was on the processing level. The next highest was on the evaluating level 545 (72%), and followed by the remembering level with 501 (66%).

**Table 15.**

**Prior Knowledge of Participants in the CORE Area in the Ohio PAT Program Across Cognition Levels**

<table>
<thead>
<tr>
<th>R</th>
<th>P</th>
<th>C</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>%</td>
<td>Score</td>
<td>%</td>
</tr>
<tr>
<td>102</td>
<td>68</td>
<td>110</td>
<td>73</td>
</tr>
<tr>
<td>56</td>
<td>37</td>
<td>110</td>
<td>73</td>
</tr>
<tr>
<td>126</td>
<td>83</td>
<td>117</td>
<td>76</td>
</tr>
<tr>
<td>88</td>
<td>58</td>
<td>112</td>
<td>74</td>
</tr>
<tr>
<td>129</td>
<td>85</td>
<td>106</td>
<td>70</td>
</tr>
</tbody>
</table>

Total 501  66  555  74  464  61  545  72
Mean 3.12  3.68  3.07  3.61
SD  1.26  1.36  1.01  1.24

R=Remembering  P=Processing  C=Creating  E=Evaluating.
Objective 7. Twenty questions were used to assess the actual level of cognition reached by the participants in the PAT program.

Table 16

<table>
<thead>
<tr>
<th>Actual Levels of Cognition Achieved by Participants in the Ohio PAT Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Score</td>
</tr>
<tr>
<td>136</td>
</tr>
<tr>
<td>84</td>
</tr>
<tr>
<td>119</td>
</tr>
<tr>
<td>127</td>
</tr>
<tr>
<td>121</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>SD</td>
</tr>
</tbody>
</table>

R=Remembering  P=Processing  C=Creating  E=Evaluating.

Table 16 showed that of 755 possible points to be scored by participants in each cognition level in the posttest exam, the highest score 587 (78%) was on the remembering level of cognition. The next was the processing level 561 (74%).
Thus, participants scores decreased as the level of cognition increased.

**Objective 8.** Achievement of participants was measured as sum of the mean of the raw score of the participants in the actual levels of cognition (posttest) exam minus sum of the mean of the raw score of participant in the prior knowledge (pretest) exam. Achievement of participants was used as the dependent variable for this study.

**Table 17.**

<table>
<thead>
<tr>
<th>Cognition Level</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering level</td>
<td>3.32</td>
<td>3.89</td>
<td>.57</td>
</tr>
<tr>
<td>Processing level</td>
<td>3.68</td>
<td>3.72</td>
<td>.04</td>
</tr>
<tr>
<td>Creating level</td>
<td>3.07</td>
<td>3.25</td>
<td>.18</td>
</tr>
<tr>
<td>Evaluating level</td>
<td>3.61</td>
<td>3.01</td>
<td>-.60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13.68</strong></td>
<td><strong>13.87</strong></td>
<td><strong>.19</strong></td>
</tr>
</tbody>
</table>
Table 17 indicated that participants achieved most at the lowest level of cognition (remembering level) followed by the creating level of cognition. The Table indicated that the prior knowledge of participants was higher than their achieved level of cognition in the PAT program across the evaluating level. Overall, the mean gain achieved by the participants in the PAT program was .19

Objective 9. To investigate if there were any significant differences between the performance of the groups of participants in the different counties across levels of cognition, one-way analysis of variance (ANOVA) was conducted for each county. The Tukey-HSD post-hoc analysis test was used in cases where some significance differences existed.

Table 18 revealed that across the remembering level, county 2 participants had the highest average percent (3.68), county 1 participants had an average percentage of 3.62, and county 3 participants had an average percentage score of 3.32. There were no significant differences among the seven counties at the .05 level.
Table 18

Analysis of Variance for Prior knowledge of Participants Across Remembering Level of Cognition

<table>
<thead>
<tr>
<th>County</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>13</td>
<td>34</td>
<td>34</td>
<td>21</td>
<td>29</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Mean</td>
<td>3.62</td>
<td>3.68</td>
<td>3.32</td>
<td>2.95</td>
<td>3.17</td>
<td>3.08</td>
<td>3.14</td>
</tr>
<tr>
<td>SD</td>
<td>.87</td>
<td>1.09</td>
<td>1.20</td>
<td>1.56</td>
<td>1.49</td>
<td>1.18</td>
<td>.90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6</td>
<td>9.91</td>
<td>1.65</td>
<td>1.04</td>
</tr>
<tr>
<td>Within Groups</td>
<td>144</td>
<td>228.83</td>
<td>1.59</td>
<td></td>
</tr>
</tbody>
</table>

Total 150 238.74

No two counties were significantly different at the .05 level.

Using one-way ANOVA, Table 19 revealed that the average scores across the processing level prior test among the groups of participants were not equal. Counties 6 and 3 had the highest mean scores of 4.46 and 4.15, respectively. County 2 had the lowest mean score (2.91).
Table 19

Analysis of Variance for Prior knowledge of Participants Across Processing Level of Cognition

<table>
<thead>
<tr>
<th>County</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>13</td>
<td>34</td>
<td>34</td>
<td>21</td>
<td>29</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Mean*</td>
<td>3.85</td>
<td>2.91&lt;sup&gt;a&lt;/sup&gt;,&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.29</td>
<td>3.83</td>
<td>4.46&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.86</td>
</tr>
<tr>
<td>SD</td>
<td>1.34</td>
<td>1.33</td>
<td>.99</td>
<td>1.53</td>
<td>1.44</td>
<td>.78</td>
<td>1.34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6</td>
<td>39.90</td>
<td>6.65</td>
<td>4.00</td>
</tr>
<tr>
<td>Within Groups</td>
<td>144</td>
<td>239.20</td>
<td>1.66</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>279.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript denote counties that were significantly different at the .05 level.

The Tukey-HSD post-hoc analysis test revealed a significance difference (alpha = .05) between county 6 and county 2 and between county 3 and county 2 in the previous knowledge test in the remembering level of cognition. Thus, it was concluded that counties 3 and 6 had significantly more prior knowledge of pesticide application across the processing
level of cognition than county 2 before attending the PAT program.

Table 20

<table>
<thead>
<tr>
<th>County</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>13</td>
<td>34</td>
<td>34</td>
<td>21</td>
<td>29</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Mean</td>
<td>3.23</td>
<td>2.79</td>
<td>3.12</td>
<td>3.10</td>
<td>3.31</td>
<td>2.85</td>
<td>3.29</td>
</tr>
<tr>
<td>SD</td>
<td>1.01</td>
<td>.95</td>
<td>1.01</td>
<td>1.26</td>
<td>.93</td>
<td>.80</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Source  | df | SS  | MS  | F  |
---------|----|-----|-----|----|
Between Groups  | 6  | 5.67| .94 | .49 |
Within Groups    | 144| 148.53| 1.03|     |
Total             | 150| 154.20|     |     |

No two counties were significantly different at the .05 level.

Table 20 revealed that across the creating level, county 5 participants had the highest average percent (3.31), county 7 participants had an average percentage score of 3.29, and county 1 participants had an average percentage score of 3.23. There were no significant differences among the seven
counties at the .05 level.

Using one-way ANOVA, the prior knowledge test (Table 21) revealed that the average scores across the evaluating level among the groups of participants were not equal. Counties 3 and 4 had the highest mean scores of 4.09 and 4.14, respectively. Counties 2 and 6 had the lowest mean scores of 2.97 and 2.85, respectively. The Tukey-HSD post-hoc analysis test revealed a significance difference (alpha = .05) between county 3 and county 6; between county 3 and county 2; between county 4 and county 6; and between county 4 and county 6 in the previous knowledge test in the evaluating level of cognition. Thus, it may be inferred that counties 3 and 4 had significantly more prior knowledge of pesticide application at the evaluating level of cognition than county 2 and 6 before attending the PAT program.
Table 21

Analysis of Variance for Prior knowledge of participants Across Evaluating Level of Cognition

<table>
<thead>
<tr>
<th>County</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>13</td>
<td>34</td>
<td>34</td>
<td>21</td>
<td>29</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Mean*</td>
<td>3.46&lt;sub&gt;a,b&lt;/sub&gt;</td>
<td>2.97&lt;sub&gt;a,b&lt;/sub&gt;</td>
<td>4.09&lt;sub&gt;b&lt;/sub&gt;</td>
<td>4.14&lt;sub&gt;a&lt;/sub&gt;</td>
<td>3.76</td>
<td>2.84&lt;sub&gt;a,b&lt;/sub&gt;</td>
<td>3.86</td>
</tr>
<tr>
<td>SD</td>
<td>1.27</td>
<td>1.42</td>
<td>.90</td>
<td>.96</td>
<td>1.09</td>
<td>1.28</td>
<td>1.46</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6</td>
<td>36.58</td>
<td>6.10</td>
<td>4.45</td>
</tr>
<tr>
<td>Within Groups</td>
<td>144</td>
<td>192.37</td>
<td>1.37</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>233.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript denote counties that were significantly different at the .05 level.

Objective 10. To determine if there were any significant differences in actual levels reached by groups of participants by county, one way analysis of variance (ANOVA) was conducted for each county.

Table 22 revealed that across the remembering level actual cognition level county 7 had the highest score (4.14).
The next highest were county 5 (4.04) and county 6 (4.00). There were no significant differences among the seven counties at the .05 level.

**Table 22**

<table>
<thead>
<tr>
<th>County</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>13</td>
<td>34</td>
<td>34</td>
<td>21</td>
<td>29</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Mean</td>
<td>3.77</td>
<td>3.88</td>
<td>3.74</td>
<td>3.81</td>
<td>4.04</td>
<td>4.00</td>
<td>4.14</td>
</tr>
<tr>
<td>SD</td>
<td>1.17</td>
<td>1.41</td>
<td>1.02</td>
<td>1.34</td>
<td>.88</td>
<td>1.00</td>
<td>.69</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6</td>
<td>2.67</td>
<td>.45</td>
<td>3.34</td>
</tr>
<tr>
<td>Within Groups</td>
<td>144</td>
<td>190.41</td>
<td>1.32</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>193.08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No two counties were significantly different at the .05 level.

Table 23 revealed that across the processing level actual cognition level achieved by participants, county 7 had the
highest score (4.14). The next highest were county 5 (4.00) and county (3.88). There were no significant difference between the seven counties at the .05 level.

**Table 23**

<table>
<thead>
<tr>
<th>Analysis of Variance of Actual Level of Cognition achieved by participants Across Processing Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>County</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>SD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6</td>
<td>12.48</td>
<td>2.08</td>
<td>1.47</td>
</tr>
<tr>
<td>Within Groups</td>
<td>144</td>
<td>239.20</td>
<td>1.66</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>200.44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No two counties were significantly different at the .05 level.
Using one-way ANOVA, the scores in the actual creating level test among the groups of participants were not equal. Table 24 showed that Counties 3, 5 and 7 were higher than other counties.

Table 24

<table>
<thead>
<tr>
<th>County</th>
<th>County</th>
<th>County</th>
<th>County</th>
<th>County</th>
<th>County</th>
<th>County</th>
<th>County</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>C2</td>
<td>C3</td>
<td>C4</td>
<td>C5</td>
<td>C6</td>
<td>C7</td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>13</td>
<td>34</td>
<td>34</td>
<td>21</td>
<td>29</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Mean*</td>
<td>3.38</td>
<td>2.44&lt;sup&gt;a&lt;/sup&gt;,&lt;sup&gt;b&lt;/sup&gt;,&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.35&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.24</td>
<td>3.90&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.15</td>
<td>4.00&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>SD</td>
<td>1.04</td>
<td>1.26</td>
<td>1.04</td>
<td>1.09</td>
<td>.86</td>
<td>1.00</td>
<td>.82</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6</td>
<td>39.02</td>
<td>6.50</td>
<td>5.80</td>
</tr>
<tr>
<td>Within Groups</td>
<td>144</td>
<td>161.42</td>
<td>1.12</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>200.44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means with the same superscripts denote counties that were significantly different at the .05 level.
The Tukey-HSD post-hoc analysis test revealed a significance difference (alpha = .05) between county 3 and county 2; between county 5 and county 2; and between county 7 and county 2 in the actual creating level achieved by the groups of participants in the pesticide training program. Thus, it may be inferred that counties 3, 5 and 7 were significantly higher than county 2 in the actual creating level of cognition in the PAT program.

Using one-way ANOVA, Table 25 revealed that the average scores in the actual evaluating level achieved by the the groups of participants by county were not equal. County 5 had the highest mean score (3.55) and county 7 had the lowest score (1.86). The Tukey-HSD post-hoc analysis test revealed a significance difference (alpha = .05) between county 5 and county 7 across the evaluating level of cognition. Thus, it may be inferred that county 5 was significantly higher than county 7 in the actual evaluating level of cognition achieved by the participants in the PAT program.
Table 25

<table>
<thead>
<tr>
<th>Analysis of Variance for Actual Level of Cognition Achieved by Participants Across Evaluating Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>County</td>
</tr>
<tr>
<td>1    2    3    4    5    6    7</td>
</tr>
<tr>
<td>n    13    34    34    21    29    13    7</td>
</tr>
<tr>
<td>Mean* 3.31  3.15  2.62  2.90  3.55a  2.92  1.86a</td>
</tr>
<tr>
<td>SD    1.11  1.56  1.28  1.22  .91   1.12  .90</td>
</tr>
<tr>
<td>Source                        df</td>
</tr>
<tr>
<td>Between Groups                6</td>
</tr>
<tr>
<td>Within Groups                 144</td>
</tr>
<tr>
<td>Total                         150</td>
</tr>
</tbody>
</table>

*Means with the same superscript denote counties that were significantly different at the .05 level.

Objective 11. Dependent t-test analysis was conducted to determine if significant differences existed between the mean percentage scores on pre-post cognition level tests for the groups of participants. The results of the t-test analyses are presented in Tables 26, 27, 28, and 30.
The t-test for the remembering level of cognition (Table 26) indicated that county 5 and county 6 groups of participants were significant higher at the actual level of cognition (posttest) than prior knowledge (pretest) at the .05 alpha level.

**Table 26**

<table>
<thead>
<tr>
<th>County</th>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest</td>
<td>13</td>
<td>3.62</td>
<td>.87</td>
<td>.37</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>13</td>
<td>3.77</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pretest</td>
<td>34</td>
<td>3.68</td>
<td>1.09</td>
<td>.72</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>34</td>
<td>3.91</td>
<td>1.33</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pretest</td>
<td>34</td>
<td>3.32</td>
<td>1.20</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>34</td>
<td>3.74</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pretest</td>
<td>21</td>
<td>3.00</td>
<td>1.56</td>
<td>1.64</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>21</td>
<td>3.81</td>
<td>1.37</td>
<td></td>
</tr>
</tbody>
</table>
"Table 26 (Continued),"

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>7</td>
</tr>
</tbody>
</table>

*p < .05

The t-test (Table 27) for the processing level of cognition showed that county 6 group of participants were significantly higher at the prior knowledge (pretest) than actual level of cognition (posttest) at the alpha .05.
Table 27

<table>
<thead>
<tr>
<th>County</th>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest</td>
<td>13</td>
<td>3.85</td>
<td>1.35</td>
<td>-.59</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>13</td>
<td>3.46</td>
<td>1.61</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pretest</td>
<td>34</td>
<td>2.91</td>
<td>1.33</td>
<td>1.61</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>34</td>
<td>3.50</td>
<td>1.42</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pretest</td>
<td>34</td>
<td>4.15</td>
<td>.99</td>
<td>-.98</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>34</td>
<td>3.88</td>
<td>1.12</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pretest</td>
<td>21</td>
<td>3.29</td>
<td>1.52</td>
<td>1.14</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>21</td>
<td>3.81</td>
<td>1.21</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Pretest</td>
<td>29</td>
<td>3.83</td>
<td>1.44</td>
<td>.52</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>29</td>
<td>4.00</td>
<td>.93</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Pretest</td>
<td>13</td>
<td>4.46</td>
<td>.78</td>
<td>-5.20*</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>13</td>
<td>3.07</td>
<td>.76</td>
<td></td>
</tr>
</tbody>
</table>
"Table 27 (continued)."

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>3.86</td>
<td>4.14</td>
</tr>
<tr>
<td>100</td>
<td>1.57</td>
<td>.90</td>
</tr>
</tbody>
</table>

*p < .05.

The t-test across the creating level of cognition (Table 28) showed that county 5 participants were significantly higher at the prior knowledge than actual knowledge at the alpha =.05.
**Table 28**

Dependent t-test for Prior Knowledge (Pretest) and Actual Learning (Posttest) for the Groups of Participants by County Across Creating Level of Cognition

<table>
<thead>
<tr>
<th>County</th>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest</td>
<td>13</td>
<td>3.23</td>
<td>1.01</td>
<td>.42</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>13</td>
<td>3.34</td>
<td>1.04</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pretest</td>
<td>34</td>
<td>2.79</td>
<td>.95</td>
<td>-1.38</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>34</td>
<td>2.44</td>
<td>1.26</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pretest</td>
<td>34</td>
<td>3.12</td>
<td>1.01</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>34</td>
<td>3.35</td>
<td>1.04</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pretest</td>
<td>21</td>
<td>3.10</td>
<td>1.26</td>
<td>.40</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>21</td>
<td>3.24</td>
<td>1.09</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Pretest</td>
<td>29</td>
<td>3.31</td>
<td>.93</td>
<td>2.25*</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>29</td>
<td>3.90</td>
<td>.86</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Pretest</td>
<td>13</td>
<td>2.85</td>
<td>.80</td>
<td>.77</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>13</td>
<td>3.15</td>
<td>.99</td>
<td></td>
</tr>
</tbody>
</table>
The t-test for the evaluating level of cognition (Table 29) indicated that county 3, county 4, and county 6 participants had significantly higher prior (pretest) knowledge than actual level (posttest) of cognition at the .05 alpha level.

Table 29

<table>
<thead>
<tr>
<th>County</th>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest</td>
<td>13</td>
<td>3.46</td>
<td>1.27</td>
<td>-.32</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>13</td>
<td>3.31</td>
<td>1.11</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pretest</td>
<td>34</td>
<td>2.97</td>
<td>1.43</td>
<td>.44</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>34</td>
<td>3.15</td>
<td>1.56</td>
<td></td>
</tr>
</tbody>
</table>

* P < .05
The t-test of significant difference between the mean percentage score for the prior knowledge (pretest) and actual knowledge (posttest) for all the participants was conducted (Table 30). The Table revealed that the participants achieved a significant gain in actual knowledge at the alpha .05 as assessed by the pre-post tests. Thus, it can be concluded that participants learned through participation in the PAT program.
<table>
<thead>
<tr>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>151</td>
<td>12.97</td>
<td>3.30</td>
<td>2.23*</td>
</tr>
<tr>
<td>Posttest</td>
<td>151</td>
<td>13.86</td>
<td>3.50</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

Pearson product moment correlations were used to determine the nature of relationship among the prior knowledge, the intended level of cognition, the actual levels of cognition reached by the participants, and learning (achievement) of the participants in the PAT program. Kendall Tau c was used to determine the relationship among cognition levels of participants, attitudes, and demographic variables. Table 31 illustrates the statistics used to determine the relationship between the dependent and the independent variables.
Table 31

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering level</td>
<td>Interval</td>
<td>Pearson product moment</td>
</tr>
<tr>
<td>Processing level</td>
<td>Interval</td>
<td>Pearson product moment</td>
</tr>
<tr>
<td>Creating level</td>
<td>Interval</td>
<td>Pearson product moment</td>
</tr>
<tr>
<td>Evaluating Level</td>
<td>Interval</td>
<td>Pearson product moment</td>
</tr>
<tr>
<td>Attitudes</td>
<td>Interval</td>
<td>Pearson Product moment</td>
</tr>
<tr>
<td>Demographic</td>
<td>Ordinal</td>
<td>Kendall Tau c</td>
</tr>
</tbody>
</table>

Davis' scale (1991) was used to describe the magnitude of association found among the variables. These conventions are described in Table 32.
Table 32

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.70 or higher</td>
<td>Very strong association</td>
</tr>
<tr>
<td>.50 to .69</td>
<td>Substantial association</td>
</tr>
<tr>
<td>.30 to .49</td>
<td>Moderate association</td>
</tr>
<tr>
<td>.10 to .29</td>
<td>Low association</td>
</tr>
<tr>
<td>.01 to .09</td>
<td>Negligible association</td>
</tr>
</tbody>
</table>

Table 33 shows Pearson product moment coefficients for the interval data and tau c for the ordinal data. The associations among the learning of students and the independent variables ranged from negligible to very strong associations.

A positive very strong relationship was found between the learning of the participants and their actual level of cognition in the PAT program. A positive low relationship was found between the learning of the participants, level of education and days worked off-farm (dependency on agriculture) by the students. A negative very strong
relationship was found between the learning of the participants and their prior knowledge (pretest) of pesticide application.

**Table 33**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual level of cognition reached by the participants</td>
<td>.74</td>
</tr>
<tr>
<td>Intended cognition level of instruction</td>
<td>-.10</td>
</tr>
<tr>
<td>Prior knowledge of the participants</td>
<td>-.71</td>
</tr>
<tr>
<td>Attitude of participants toward information given through the PAT program</td>
<td>-.03</td>
</tr>
<tr>
<td>Attitude of participant toward the PAT program</td>
<td>-.03</td>
</tr>
<tr>
<td>Attitude of participants toward the methods of instruction used</td>
<td>.04</td>
</tr>
<tr>
<td>Level of education</td>
<td>.10</td>
</tr>
<tr>
<td>Age</td>
<td>.02</td>
</tr>
<tr>
<td>Dependency on agriculture</td>
<td>.11</td>
</tr>
</tbody>
</table>
Table 34 shows the relationship among the independent variables in the study. The Table revealed a negative low relationship between the actual level of cognition reached by the participants and intended level of instruction, and between the actual level of cognition reached by the participants and level of education of the students. A positive low relationship was found between the attitude of
students toward the PAT program, attitude toward the methods of instruction used in the PAT program, and intended level of instruction. A negative low relationship was found between intended level of instruction and the level of education of participants.

In order to identify important variables predictive of actual and intended levels of cognition, multiple regression statistical analysis was conducted. Using a stepwise procedure, a multiple regression model was specified for the following variables: attitude toward information given in the training program, attitude toward the training program, attitude toward the method of instruction used in the training program, level of education, age of the students, and dependency on agriculture as predictors of the actual level of cognition reached by the students and intended level of cognition of instruction:

\[ Y' = a + b_1 x_1 + b_2 x_2 + \ldots + b_k x_k \]

\( Y' \) = the estimated value of \( Y \)
\( x_1, x_2, \ldots, x_k \) are the independent variables
\( a \) = intercept; estimated value of \( Y \) when each variable is zero
\( b_k \) = partial regression coefficient.

This analysis partialled out the effects of a single variable
at each step, while other variables were statistically controlled.

Stepwise regression analysis in Table 35 showed that a significant portion of the variance associated with the intended level of instruction could be explained by attitude toward method of instruction. Four percent of the variance in the intended level of cognition of instruction could be explained by attitude of the participants toward the method of instruction used in the pesticide training program. Variables which did not enter the equation were attitude toward information given in the PAT program, attitude toward the PAT program, level of education, age of the students; and dependency on agriculture. Participants' age and attitude toward the PAT program were shown to be significantly related to instructors intended level of cognition of instruction but did not explain a significant part of the variance in intended level of cognition. This indicated that age and attitude of participants toward the PAT program were not predictors of intended level of cognition of instruction.
Table 35

<table>
<thead>
<tr>
<th>Variable</th>
<th>b</th>
<th>B</th>
<th>R²</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>.141</td>
<td>.198</td>
<td>.039</td>
<td>6.15</td>
<td>.01</td>
</tr>
</tbody>
</table>

Table 36 presents the stepwise regression analysis used to predict the actual level of cognition achieved by the participants from the attitude toward information given in the training program, attitude toward the training program, attitude toward the method of instruction used in the training program, level of education, age of the students, and dependency on agriculture. Four percent of the variance in the actual level of cognition reached by participants was explained by their levels of education. Variables which did not enter the equation were attitude toward information given in the training program, attitude toward the training program, attitude toward the method of instruction used in the training program, age of the students, and dependency on agriculture. Participants' dependency on agriculture was shown to be significantly related to actual level of cognition but did not explain a significant part of actual
level of cognition reached by participants. The result indicated that participants' dependency on agriculture was not a predictor of actual level of cognition achieved by participants in the PAT program.

Table 36

<table>
<thead>
<tr>
<th>Variable</th>
<th>b</th>
<th>B</th>
<th>R²</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of education</td>
<td>.632</td>
<td>.191</td>
<td>.037</td>
<td>5.66</td>
<td>.02</td>
</tr>
</tbody>
</table>
SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This chapter was organized as follows: purpose of the study, summary of procedures, summary of research findings, conclusion and recommendations.

Purpose of the Study.

The purpose of this study was to assess the learning (achievement) of the participants in the Ohio PAT program. Specifically this study sought to:

1. Determine the attitudes of the participants toward the information given through the PAT program.
2. Determine the attitudes of participants toward the PAT program.
3. Determine the attitudes of participants toward the methods of instruction used in the PAT program.
4. Determine the selected demographic characteristics of participants in the PAT program.
5. Determine the intended cognitive levels of instruction in the PAT program.
6. Determine the prior knowledge of participants in the core area.
7. Determine the actual cognition levels achieved by
participants in the core area.

8. Determine the learning (achievement) of the participants in the core area.

9. Determine significant differences in prior knowledge between the groups of participants by county.

10. Determine significant differences in actual levels of cognition achieved by the groups of participants by county.

11. Determine significant differences between prior knowledge and actual level of cognition of participants by county.

12. Determine significant difference between prior knowledge and actual level of cognition of all the participants.

13. Determine the relationship between the learning of the participants and the independent variables.

14. Determine the relationship among the intended levels of cognition of instruction and prior knowledge of participants.

15. Determine the relationship among the actual level of cognitions achieved by the participants and the prior knowledge of participants.

16. Determine how intended levels of instruction vary with attitudes and selected demographic variables.
17. Determine how actual cognition level achieved by participants vary with attitudes and selected demographic variables.

18. Determine how the learning of the participants vary with attitudes and selected demographic variables.

Summary of Procedures

Research Design

This was an ex post facto research design which allowed the researcher to determine and describe the relationship between variables. The following dependent and independent variables were used to guide this study:

Dependent variable: The dependent variable for this study was the learning (achievement) of the participants in the PAT program.

The main independent variables. The main independent variables were:

A. Intended levels of cognition at which the county agricultural agents planned to deliver the program.

B. The prior knowledge of the participants in the PAT program in the core area.

C. The actual levels of cognition reached by the participants in the PAT program in the core area.

Rival variables. The rival variables for this study were

A. Attitude toward the information given through the PAT
program.

B. Attitude of participants toward the program.

C. Attitude of participants toward methods of instruction used to deliver the PAT program.

D. Level of education of participants.

E. Age of participants.

F. Dependency on agriculture.

Population and sample

The target population for this study consisted of the participants in the 1992/93 Ohio PAT program. The accessible population was 151 participants in the 1992/93 PAT programs from seven counties in Ohio who self-selected to participate in the study.

Instrumentation: The remembering level of the instrument used to collect data for prior knowledge and actual level of cognition was adapted from Hall, et al. (1991). The processing, creating, and evaluating level questions, and the attitude and demographic variables were developed by the researcher. Data for the intended levels of cognition were collected with an interview schedule used by Bhardwaj (1988). Reliabilities for the instruments were established using Cronbach's alpha and inter-rater reliability. Validity for the instruments was established using a panel of experts.
Summary of Major Findings

This section summarized the findings associated with the objectives of the study as follows:

Objective 1: Determine the attitude of the participants toward the information given through the PAT program. The participants agreed most about picking out important informations on a typical pesticide label followed by practicing safety measures to prevent injury to self, others, and the environment, and understanding the laws regulating pesticides. Overall, participants indicated a favorable attitude toward the information given in the PAT programs.

Objective 2. Determine the attitude of the participants toward the PAT program. The participants agreed most that the PAT program should be continued, and that they were happy to have participated in the PAT program. The participants disagreed most that the training program held their interest. Overall, the participants showed a more negative than a positive attitude toward the program.

Objective 3. Determine the attitude of participants toward the methods of instruction used to deliver the PAT program. The participants indicated that the three most important
methods of instruction used to deliver the PAT program were Agents guide, Manual, and lecture meetings. Demonstration was the least rated method of instruction used to deliver the PAT program. Overall, participants indicated favorable attitude toward methods of instruction used to deliver the PAT program.

**Objective 4.** Determine the selected demographic characteristics of the participants in the PAT program. The selected demographic characteristics of the participants for this study were level of education, age, and dependency on agriculture. Sixty-six (43.7%) of the participants completed high school or equivalent, 37 (24.5%) had some college education, and 25 (19.2) had some high school grade (9-12). Sixty-one (40%) of the participants were between the age of 31 and 40, 30 (19.9%) were between the age of 41 and 50, and 25 (16.6%) were between the age of 21 and 30. The average age of a typical participant was 36 years. Forty-five (29.8) of the participants worked 200 or more days off-farm in the last 12 months while 38 (25.2%) did not work off-farm.

**Objective 5.** Determine the intended levels of cognition of instruction in the PAT program. The most frequent intended level of instruction which the agricultural agents planned to
deliver the program was the remembering level of cognition. The next was the evaluating level. This finding supported the previous studies by Ismail (1992), Cano (1988), Wittington (1991), and Bhardwaj (1989). The scores of the participants in the prior knowledge test indicated a low level of cognition.

Objective 6. Determine the prior knowledge of the participants in the CORE area. Of 755 possible points to be scored by the participants in each cognition level on the pretest exam, the highest score (555 points) was at the processing level, followed by the evaluating level (545). The lowest was on the creating level (464 points).

Objective 7. Determine the actual level of cognition achieved by the participants in the PAT program. Of 755 possible points to be scored by the participants in each cognition level on the posttest exam, the highest score (587) was at the remembering level, followed by the processing level (561). The lowest score was on the evaluating level (454). This finding supported the previous study by Wittington (1991) by finding the assessed highest discourse for participants at the remembering and processing levels. Thus, the highest actual level of cognition reached by the participants was the remembering level.
Objective 8. Determine the learning (achievement) of the participants in the CORE area of the PAT program. The participants achieved most at the lowest level of cognition (remembering level) followed by creating level of cognition. The participants scored higher on the prior knowledge exam than in the actual level of cognition at the highest level of cognition (evaluating level). When the average scores of the participants were considered together for all the cognition levels, it was concluded that participants learned in the PAT program, but mainly in the remembering level.

Objective 9. Determine significant differences in prior knowledge between the groups of participants by county. There was no significant difference at the alpha .05 in prior knowledge between the seven counties across the remembering and creating levels of cognition.

The Tukey-HSD post-hoc analysis test revealed a significance difference (alpha = .05) between county 6 and county 2, and between county 3 and county 2 in the prior knowledge test across the remembering level of cognition. Thus, it was concluded that counties 3 and 6 had significantly more prior knowledge of pesticide application at the processing level of cognition than county 2 before attending the PAT program.
The Tukey-HSD post-hoc analysis test also revealed a significance difference (alpha = .05) between county 3 participants and county 6; between county 3 and county 2; between county 4 and county 6; and between county 4 and county 6 in the prior knowledge test across the evaluating level of cognition. Thus, it may be concluded that participants in counties 3 and 4 had significantly more prior knowledge of pesticide application at the evaluating level of cognition than county 2 and 6 before attending the PAT program.

**Objective 10.** Determine significant differences in actual levels of cognition (posttest) reached by the groups of participants by county. There were no significance differences found between the counties in actual levels reached by the participants across the remembering and processing levels of cognition at an alpha of .05.

The Tukey-HSD post-hoc analysis test revealed a significance difference (alpha = .05) between county 3 and county 2; between county 5 and county 2; and between county 7 and county 2 in the actual level of cognition reached by the groups of participants in the pesticide training program across the creating level. Thus, it may be concluded that participants in counties 3, 5 and 7 attained significantly more than county 2 in the actual creating level of cognition.
in the PAT program.

The Tukey-HSD post-hoc analysis test revealed a significance difference (alpha = .05) between county 5 and county 7 in the actual level of cognition across the evaluating level. Thus, it may be concluded that participants in county 5 attained significantly more than county 7 in the actual evaluating level of cognition.

Objective 11. Determine the significant differences between prior knowledge and actual level of cognition by the groups of participants by county.

Across the remembering level, participants in county 5 and county 6 were significantly higher in actual knowledge than prior knowledge at the .05 level. Across the processing level, participants in county 6 were significantly higher in actual knowledge than prior knowledge at the alpha .05 level. Across the creating level, county 5 was significantly higher in prior knowledge than actual level reached by the participants. Across the creating level participants in counties 3, 4, and 7 were significantly higher in prior knowledge than actual knowledge achieved by the students. The negative signs in the t-test tables indicated counties that were higher in prior (pretest) knowledge than actual level of cognition (posttest) achieved by participants.
Objective 12. Determine the significant difference between prior knowledge and actual level of cognition of all the participants. Overall, there was a significant gain between prior knowledge and actual level of cognition achieved by the participants at the alpha .05 level.

Objective 13. Determine the relationship between the learning of the participants and the independent variables. The relationship between the learning of participants and the independent variables ranged from negligible to very strong association ($r = .02$ to $r = .74$). A positive, very strong, relationship was found between the learning of the participants and their actual level of cognition achieved by participants in the PAT program ($r = .74$). A positive, low, association was found between the learning of the participants and dependency on agriculture ($r = .11$). Also a positive low association was found between the learning of the participants and their level of education ($r = .10$). A negative, very strong, association was found between the learning of the participants and their prior knowledge (pretest) of pesticide application ($r = -.71$).

Objective 14. Determine the relationship among the intended cognition levels of instruction and prior knowledge variables.
A negative, negligible relationship was found between the intended level of cognition and prior knowledge of participants ($r = -0.03$).

**Objective 15.** Determine the relationship among the actual cognition level reached by the participants and prior knowledge. A negative, negligible relationship was found between the actual level of cognition achieved by the participants and prior knowledge ($r = -0.05$).

**Objective 16.** Determine how intended cognition levels of instruction vary with the attitudes of participants, and selected demographic variables.

Stepwise multiple regression showed that a significant portion of the variance associated with the instructors' intended level of instruction could be explained by the participants' attitude toward methods of instruction. Four percent of the variance in the intended level of cognition of instruction could be explained by the attitude of the students toward the method of instruction used in the pesticide training program.

**Objective 17.** Determine how actual level of cognition vary with other independent variables. Stepwise multiple regression revealed that 4 percent of the variance in the
actual level reached by the participants was explained by their levels of education.

Objective 18. Determine how the learning (achievement) of the participants vary with attitudes and selected demographic variables.

Although some relationships existed between the attitudes of the participants and selected demographic characteristics and the learning (achievement) of the participants, this study was unable to identify attitude or demographic characteristics which could explain a significant portion of the variance associated with participants' achievement. Data were not reported in chapter IV because of the inability of the attitude and selected demographic variables to explain the variance associated with participants' achievement (Appendix L).

Conclusions

The following conclusions were made based on the findings from the study; the objectives of the study; the 151 applicators who participated in this study; the seven agricultural agents who delivered the PAT programs in the seven counties studied; and the analysis of the data.

Overall, the participants demonstrated a favorable attitude toward the information given in the PAT program.
Participants' attitude could be an indication of the effectiveness of the PAT program in meeting their needs and interests. The PAT program can be described as an effective source of information based on the positive attitude of participants. However, some participants indicated that the PAT programs did not hold their interest to the end of the program. This revealed that the PAT program should be continued but improved to sustain the interest of the participants throughout the program. The program can be improved by conducting a study to determine the factors that might limit the interest of participants in the PAT program. Further, motivational techniques introduced throughout the instructional session should be beneficial.

The "Agents guide" was ranked the best method of instruction used in the PAT program. The next highly rated was the "Manual". Demonstration was the lowest in the rank order of importance.

Achievement increased with increased dependency on agriculture. Thus, the more dependency on agriculture by participants, the more they learned in the PAT program. The researcher expected dependency on agriculture to explain more of the variance associated with participants achievement in the PAT program. Achievement in the PAT program also increased with increased level of education. This supported the findings of Ladewig and Chickering (1981). Their
findings showed a positive relationship between educational attainment and participation in an educational program. Better educated persons were more knowledgeable about new learning practices and eager to learn more.

The actual level of cognition achieved in the PAT program increased with increased level of education. Thus, the higher the level of education, the higher the actual level achieved in the PAT program. Also better educated persons were more knowledgeable and eager to learn more new learning practices.

The level of cognition the agricultural agents intended to deliver the PAT program increased with a favorable increase of attitude toward the information given and the methods of instruction used in the PAT program. Participants' attitude toward information given and methods of instruction were indications of the effectiveness of the PAT program in meeting their needs and interests if taught as intended by the instructors.

The county agricultural agents who participated in this study intended to deliver the program primarily at the remembering and evaluation levels. The participants in this study learned primarily in the remembering level. This indicated that the county agents who intended to delivered the program at the lowest level actually delivered it as they intended and those who intended to deliver the program at the
highest cognition level actually delivered primarily at the lower levels. One might argue that the participants were low achievers at the higher cognition levels. Overall, the participants made significant gains in learning (achievement) in the PAT program.

Based on the findings from this study, it may be concluded that participants learned in the PAT program primarily at the remembering level which involved the ability of the participants to memorize and recall simple, concrete facts and definitions taught in the PAT program. Some counties learned little in the PAT program at the creating and evaluating levels. Mewcomb and Trefz (1987) indicated that the creating and evaluating levels: (1) required the ability of the instructors to combine pieces of information provided in the program in a form that is new to the participants, (2) required the participants to be able to think independently and to make independent self expression, and (3) involved the ability of the participants to make a judgement or critical evaluation for a given set of information given in the PAT program.

RECOMMENDATIONS

Based on the findings of this study and the literature on cognition and adult education programs, the following recommendations are made for these groups of audiences: the
county extension agents, the CCES, the ODA, and EPA.

The County Extension Agents

The county extension agents should be familiar with the levels of cognition such as Bloom's taxonomy or the Newcomb & Trefetz model by attending workshops on cognition. Before the agents can teach for higher order cognition, they must possess an understanding of the cognitive levels. Cognition and critical thinking are new games with new rules and requiring new approaches to teaching and learning (Parker, 1993).

The county extension agents planned to deliver the PAT program mostly at the lowest and highest levels of cognition while the participants learned primarily at the lowest level of cognition. The agents should aspire to deliver the PAT program at the higher levels of cognition so as to raise the achievement of participants in the PAT program.

Demonstration was the lowest rated method of instruction used to deliver the PAT program. PAT program educators should stress learning by doing because this is the way the participants can test their knowledge. Time must be provided to practice the learning so the participants could gain confidence on what they learned. Maurer et al. cited by Coklin (1991) recommended that time should be selected which give the participants an opportunity to apply the knowledge
achieved.

The OCES

This study supported the recommendation by Ismail (1992) on hiring county agricultural agents. He recommended that when hiring county agricultural agents. Henderson (1988) noted that persons who have knowledge of cognition and who combine their knowledge and experiences to teach will help improve the cognitive, problem solving skills of participants, and will bring the most up-to-date cognitive knowledge to their participants.

Since "Agents Guide", "Manuals" and "lecture meetings" were the major important methods of instruction for pesticide educators as revealed by this study, The OCES should encourage their authors to include materials which emphasize learning at higher cognition levels.

The OCES and other States' CES should allocate time to field demonstration. The CES should encourage the PAT instructors to lay more emphasis on demonstrating some important topics such as calibration, spraying, and insect identification. The participants can act as teachers. Coklin indicated that when participant act as teachers, their ability to learn would be increased.
The ODA

Since the ODA is responsible for testing participants in PAT program, they should attend workshops on developing tests for higher cognitive levels. Agricultural agents should be involved in developing the examination used for certification. ODA should expect OCES and the PAT program instructor to have a knowledge of cognitive levels.

EPA

EPA in its respond to complex changes and widespread use of pesticides in the country, and in its effort to provide participants in PAT program with adequate and comprehensive instruction in the safe use of pesticides, should emphasize on the design and methods of delivering the PAT program to include cognitive levels. This should promote higher learning (achievement), ethical decision making, and problem solving among the participants.
Implications of the Study

The findings of this study and the literature reviewed clearly indicated four main implications.

1. Lack of assessment of the prior knowledge of the students.

From the interview schedule, the instructors of the PAT program indicated that there was a mixture of participants with various levels of experience in pesticide application. Wang et al. (1985) emphasized that prior knowledge in an educational program should serve as an important base for improving an educational program. The study clearly indicated that the prior knowledge of the participants in some counties were higher than the actual level of knowledge achieved in the PAT program. Thomas and Englund, 1990; Evans, 1987 emphasized the powerful effect that prior knowledge has upon current learning and cognition. Rogers (1988) noted that "in many cases the people we train know enough already and possess enough skills". He went on to say "what prevents them from pursuing the desired activity is lack of confidence". Syinicki (1993) revealed that a goal of learning is to incorporate new information into prior knowledge. Participants in educational programs use prior
knowledge to assimilate new information. He further indicated that presenting new information in its relation to prior knowledge not only helps participants learn the new information but strengthens the old.

PAT instructors did not tend to conduct an assessment of participants' level of prior knowledge before beginning instruction. Incorporating into their style of teaching information regarding their participants' prior knowledge and learning would be helpful to PAT instructors in raising the achievements of the participants.

2. Lack of Evaluation.

When asked whether an evaluation or assessment would be conducted before or after the PAT program, the instructors indicated that no evaluation or assessment would be conducted. Maurer et al. (no date) recommended that effective evaluation be conducted of extension programs. Formative evaluation should be conducted during the program to ensure that the program is proceeding in the desired direction. Effective summative evaluation should be conducted at the end of the program to determine whether or not the program has reached the objectives that were intended in the planning process. PAT instructors did not conduct formative and summative evaluations.
3. **Lack of lesson plans.**

The study clearly indicated a lack of lesson planning. When the instructor were asked if they had lesson plans, they indicated that, basically, they used no lesson plans. The agents believed in developing lesson plans but depended on the video tapes provided by The Ohio State University. The extension literature has emphasized the development of lesson plans in extension educational programs.

If the years ahead are indeed the decade of teaching extension clientele how to further develop, use, and improve their cognition skills in order to become better thinkers, problem solvers, and decision makers as suggested by Henderson (1988); the result of this study provided useful information as educators plan PAT programs. The increase in the use of pesticides required responsible use of the pesticides to make their application not only appropriate but safe.

4. **Learning.** The PAT instructors indicated that the purpose of the PAT program was primarily to prepare pesticide applicators for certification. Reducing the number of reports and investigations made by the ODA Pesticide Regulation Section (PRS) required that participants learn at higher cognition levels. Certification is important, but there is a greater chance of further reducing the number of pesticide accidents by teaching and learning at higher
cognitive levels. Learning at higher cognitive level depends upon active involvement of the learner in the teaching and learning interaction. Participants learned primarily at the lowest level. Little was learned at the higher levels of cognition. The learning implication supported the studies by Whittington (1991), and Ismail (1992). Whittington found that the assessed discourse for college participants was primarily at the remembering level. Ismail found that a majority of the county agents actually delivered OCES programs at the comprehension and application levels which are the processing level in the Newcomb-Trefz model.

**Recommendations for Further Study**

1. The study needs to be replicated in different counties and states, with different agents and participants.
2. A study is needed to investigate the effects of evaluation and lesson plans on the achievement of the participants in the PAT programs.
3. Further research is needed to identify other affective and demographic characteristics of participants that could better predict the achievement of the participants in the PAT program.
4. Research should be conducted to assess the cognition level of instructors who deliver the PAT program and to
determine its relationship to the learning of participants.

5. Research should be conducted to assess the highest cognition level at which PAT instructors deliver the PAT program and its relationship to the learning and level of cognition achieved by participants in the PAT program.
Ohio Counties Studied
Morrow
Fairfield/Perry
Licking
Medina
Lorain
Putnam
Warren
Trial Examination for Pesticide Applicators.

Number_________________________County_________________________

The purpose of this exam is to measure what you have learned from the pesticide training program. Your scores will be confidential and will only be reported for the whole class.

Instructions: Read the questions carefully and circle the correct answer to each question.

1. What are the two types of provision included in FIFRA Act of 1972?
   a. Registration of all pesticide and equipments.
   b. Classification of all pesticides into general or restricted use and application of restricted use pesticides by certified applicators.
   c. Use of pesticides inconsistent with the label and inspection of plants.
   d. Registration of all pesticides by a certified applicator.

2. What are the two major types of pesticide exposure?
   a. Acute and short term.
   b. Chronic and long term.
   c. Acute and chronic.
   d. All of the above.
3. What are the three main body parts of an adult insect?
   a. Three pairs of wings, head, thorax.
   b. Abdomen segments, thorax.
   c. Head, eye, three pairs of wings.
   d. Head, thorax, abdomen.

4. What is the most appropriate first aid procedure to follow when a person swallows a pesticide?
   a. Rush the victim to the physician.
   b. Wait for the arrival of emergency 911.
   c. Lay the victim on back and induce vomiting.
   d. Take the person home.

5. Certification may only be obtained initially in Ohio by
   a. Sitting through three hour of recertification training.
   b. Paying the license fee.
   c. Passing appropriate examinations and applying for a license.
   d. Attending an approved training session.
6. If a farmer has 750-gallon spray tank and the sprayer is calibrated to apply 25 gallons per acre (GPA). How many acres can the farmer spray with one full tank?

a. 15 acres.
b. 20 acres.
c. 25 acres.
d. 30 acres.

7. Which of the following pesticide handling practices could most likely lead to trouble when handling pesticides?

a. Measuring accurately.
b. Transportation of pesticides.
c. Selecting the right pesticides.
d. Mixing and loading of chemical pesticides.

8. Smith had an outbreak of pests in his farm. He bought a pesticide. He followed the directions on the label. But unfortunately, Smith spilled the pesticide outside the target area. With your knowledge of pesticides, which method of dealing with a pesticide spill would you advise Smith to use?

a. Hose down the area with lots of water.
b. Contact your insurance agency immediately.
c. Contain and clean up the spill.
d. Drive cattle into the area to trample the spill area.
9. As a pesticide applicator in Ohio, you intend to draw water from a stream, ditch, pond, lake, river, or from a public water supply to fill your pesticide application equipment. Which one of the following devices is required by Ohio law to prevent backflow?

a. A stainless steel valve before tank and at inlet.

b. An in-line strainer to prevent drift, algae and other contaminants from entering the spray tank.

c. An anti-siphon device.

d. A roller pump, plus the steel valves with a strainer.

10. Any nozzle that has a flow rate of 5 percent more or less than the average of the nozzles in the system should be replaced. Suppose the average of the boom nozzle is 8 oz/minute. Five percent of 8 is 0.4 (1 percent of 8=0.08, 5 x 0.08=.40). Which of the following nozzles should be replaced?

<table>
<thead>
<tr>
<th>Nozzle</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>8.3 oz/min.</td>
</tr>
<tr>
<td>b.</td>
<td>8.5 oz/min.</td>
</tr>
<tr>
<td>c.</td>
<td>7.8 oz/min.</td>
</tr>
<tr>
<td>d.</td>
<td>8.1 oz/min.</td>
</tr>
</tbody>
</table>
11. Proper use and maintenance of pesticide application equipment is essential for safe, effective pest control. You have just bought sprayer equipment. Outline your plan for the maintenance of this sprayer. Choose from the following outlines:

a. Drain and rinse the sprayer about once a month. Use water pumped directly from a well.

b. Use clean knife, screw driver or heavy gage steel wire to clean the nozzle.

c. Use clean water, keep screen in place, use chemicals that sprayer and pump were designed to use, flush the sprayer before using it and clean the sprayer thoroughly after use.

d. Use liquid fertilizers, use a metal object immediately after use.

12. You choose to control the plant disease on your farm by cultural practices alone. Tell how you would control plant disease by this method.

a. Cultural practices include exclusion, eradication, and resistance. Selection of resistance or tolerant varieties of plants. Proper establishment of plants, rotating planting location.

b. Cultural practice involves the principle of protection. Placing a protective cultural barrier between the plant and the pathogen.

c. Use plants that are susceptible to the disease since the plant may develop immunity.

d. Plant before the disease matures. Wash the seeds with clean water in order to wash out the pathogen.
13. The pesticide you choose to apply may be available in many formulations. Tell the factors you should consider when you want to choose among different formulations.

a. Whether the formulation will cause unwanted harm to plants, animal, or surface in the application site. Application equipment available and best suited for the job. Risk to applicator, habit and growth patterns of the pest.

b. Type of space available, surface cleanliness, and surface moisture.

c. Temperature, cost considerations, and humidity.

d. Presence of direct sunlight, possibility of rain or watering, and air movement.

14. You have been approached by an unlicensed farmer to combine a number of pesticides he bought. He will hire another applicator to apply the combination in the same farm. Which of the following factors would you consider when making the combination?

a. Compatibility, find a chart that lists the compatibility of the pesticides that you wish to mix. Test a small amount of the mixture before you mix large quantities.

b. Incompatibility, but time labor and fuel saving. No need using charts since mixing the pesticides will not present a problem.

c. Consult your county agent for advise before mixing the pesticides. He will tell you the quantity of each pesticide that you will add to the mixture.

d. Mix using closed combination and mechanical system equipments. Use open mixing vats or tanks or open pouring.
15. Develop an evaluation model to assess the goals of Integrated Pest Management (IPM). The goals of IPM are improved control, pesticide management, economic crop protection, and reduction of potential hazards. Which one of the following models would you use?

a. Breeding and selection of resistant crop varieties to protect key pests. Using natural enemies to regulate the pest population, and avoidance of peak pest population. Preventive pesticides such as herbicides and fungicides. Improved pesticide application.

b. Using existing basic principles of effective IPM followed such as exclusion, suppression, eradication and plant resistance stresses.

c. Allowing all the key holders to benefit from IPM activities. The holders are farmers, gardeners, turfgrass and park managers, workers, users, fish and wildlife.

d. All of the above will be included in the model.
16. The U. S. Environmental Protection Agency (EPA) has revised its Worker Protection Standard (WPS) dealing with the protection of agricultural workers from pesticide exposure. EPA has determined that its old regulation was inadequate to protect agricultural and pesticide handlers who are occupationally exposed to pesticides and their residues. Do you agree that the new regulation is better than the old regulations. Why or why not?

a. The old WPS is better than the new WPS because the old WPS covered pesticides handlers, often the most highly exposed employees.

b. The old WPS is better than the old WPS because the old WPS permitted workers to perform hand labor in treated areas during Re-Entry Intervals with protected clothing that is inadequate by today's standard.

c. The new standard is better than the old standard because the new standard expands the scope of coverage in the old standard to include not only workers performing hand labor operations in fields treated with pesticides, but also employees in forest, nurseries, and greenhouses, along with employees who handle pesticides for use in these locations.

d. All of the above.
17. The U. S. Environmental Protection Agency (EPA) has revised its Worker Protection Standard (WPS) dealing with the protection of agricultural workers from pesticide exposure. EPA predicts that a total of about 560,000 farms, forests, nurseries, and green house are covered by the new rule. In addition, about 8,000 commercial pesticide handling establishments will be covered with respect to their agricultural-related activities. The categories of establishments are:

<table>
<thead>
<tr>
<th>Category</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed and Grain</td>
<td>301,000</td>
</tr>
<tr>
<td>Cotton</td>
<td>21,000</td>
</tr>
<tr>
<td>Tobacco</td>
<td>57,000</td>
</tr>
<tr>
<td>Other Field</td>
<td>71,000</td>
</tr>
<tr>
<td>Vegetable/Fruit/Nut</td>
<td>79,000</td>
</tr>
<tr>
<td>Nursery/Greenhouse</td>
<td>31,000</td>
</tr>
<tr>
<td>Commercial Pesticide Handling</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>568,000</strong></td>
</tr>
</tbody>
</table>

Based on the prediction figures above, which category is the second highest covered by the rule?

a. Cotton.

b. Other Field.

c. Vegetable/Fruit/Nut.

18. Persons who buy or use restricted-use pesticides must be certified as competent applicators or must be directly supervised by certified applicators. Do you agree? Why or why not?

a. No, restriction of restricted use pesticides to registered applicators does more harm than good to the public. It limits the successful use of pesticides and increases the number of pesticide drifts each year.

b. Yes, restriction of restricted use pesticides to registered applicators increases the sale of pesticides and the quantity of pesticides manufactured annually.

c. Yes, restricted use means that the pesticide has been shown to be likely to harm people or environment if it is not used correctly. Registered applicators have been trained and certified as competent in the use of restricted use pesticides and they are more likely to use pesticides as directed in the pesticide labels.

d. No, it does not matter who uses restricted Use pesticides. There will continue to be cases of pesticide hazard.
19. Below is a sample label from a home study course book. Note any errors, any incomplete information and analyze it in terms of the appropriateness and completeness of the information. Which one of the following analyses would you choose?

---

**RESTRICTED USE**

**PESTICIDE**

FOR RETAIL SALE TO AND APPLICATION ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION

---

**PRODUCT NAME**

ACTIVE INGREDIENT ___%  
INERT INGREDIENT ___%  

TOTAL 100.00%  

THIS PRODUCT CONTAINS ___ LBS OF ___ PER GALLON  

KEEP OUT OF REACH OF CHILDREN  

DANGER_POISON

---

STATEMENT OF PRACTICAL TREATMENT  

IF SWALLOWED ________  
If inhaled ________  
IF ON SKIN ________  
IF IN EYES ________  

---

Please turn over
a. The ingredient statements on the label stated the amount of active ingredients only. The product name is DEPESTO. The statement of practical treatment is easy to follow. The product contains 100 lbs of active ingredient per gallon. No modification is needed.

b. The name of the manufacturer is given. The label told us that the pesticide control mites, worms and mosquitoes. The storage and disposal methods were appropriate.

c. Restricted use stated that the pesticide is for retail sale to and application only by certified applicators or persons under their direct use. The product name, percentage of ingredients, content of the product and practical treatment procedure were not given. Therefore, the label is incomplete and inappropriate.

d. A and b. are applicable. Therefore, the label is very appropriate.

20. United States Department of Agriculture (USDA) regulates the use of pesticides in the United States. Do you agree with mandatory regulation of pesticides? Why or why not?

a. No, mandatory regulation of pesticides limits the successful use of pesticides.

b. Yes, mandatory regulation pesticides protects the user of the pesticide, the consumer of the treated products, and the environment.

c. No, mandatory regulation of pesticides limits the sale of pesticides.

d. Yes, mandatory regulation of pesticides increases the number of pesticide drifts per year.
Number__________  County__________

The purpose of this exam is to measure what you have learned from the pesticide training program. Your scores will be confidential and will only be reported for the whole class.

**Instructions**: Read the questions carefully and circle the correct answer to each question.

1. What type of ingredient statement can be found on a pesticide label?
   a. Name of the certified applicator.
   b. The amount of active and inert ingredient.
   c. Ohio Department of Agriculture.
   d. All of the above.

2. What benefits are obtained from calibration of spray equipment?
   a. Illegal pesticide residue.
   b. Injury to plants and animals.
   c. Excess run-off.
   d. None of the above.
3. Which of the following statements will appear on all pesticide labels?.
   a. Caution.
   b. Warning.
   c. Danger.
   d. Keep out of Reach of Children.

4. Pesticides that build up in the body of organisms are said to be
   a. Pumping iron.
   b. Additives.
   c. Accumulative.
   d. Adjuvants.

5. What two steps are included in the calibration process?.
   a. Buying the right chemical and equipment.
   b. Checking the pressure at the nozzle and buying the right chemical.
   c. Determining actual travel speed and buying the right equipment.
   d. Checking the pressure at the nozzle and determining actual travel speed.
6. Which of the following application practices is recommended when applying pesticides?

a. Use any equipment or method of application as long as it is not prohibited by label.

b. Apply the pesticide with an equipment of your choice.

c. Use the pesticide consistent with the label.

d. Apply the material against any target pest not on the label as long as the pesticide can control the pest.

7. A sprayer has six nozzles. In a one minute flow check, an applicator finds the flow rate shown below. Which of these nozzles should be replaced?

<table>
<thead>
<tr>
<th>Nozzle</th>
<th>Flow Rate (in fluid oz./min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>8.0</td>
</tr>
<tr>
<td>b</td>
<td>7.5</td>
</tr>
<tr>
<td>c</td>
<td>8.2</td>
</tr>
<tr>
<td>d</td>
<td>7.8</td>
</tr>
</tbody>
</table>

8. If strong winds come up during your pesticide application, which of the following drift preventions would you use?

a. Stop the application immediately.

b. Finish the application, but at a slower pace.

c. Finish the application, but at a lower sprayer pressure.

d. Continue the application unless drift becomes a problem.
9. If your child accidentally swallows a pesticide, which of these first aid procedures would be most appropriate?
   a. A salt solution to induce vomiting.
   b. Lay the child on back and induce vomiting.
   c. None of the above.
   d. All of the above.

10. Which of the following protective cloth procedures could lead to trouble when handling pesticides?
    a. Wearing a long-sleeve shirt.
    b. Wearing a coverall-type garment.
    c. Tucking trouser legs inside your boots.
    d. Wearing a raincoat for highly toxic material.
11. As a manager of a large farm, you are interested in buying a low-pressure boom sprayer. Outline how you would use the sprayer and why. Choose one of the following outlines.

a. Low-pressure boom sprayers operate with dilute mixtures, pressure can be regulated up to several hundred pounds. Low-pressure sprayers are useful for many different pest control jobs. Because they are strongly built, they are long lasting and dependable.

b. Low-pressure sprayers are often used to apply pesticides to small areas. They are easy to operate, clean and store.

c. Low-pressure sprayers are primarily designed to carry pesticide-water mixtures under pressure from a pump through a series of nozzles into a blast of air that blows into the tree by means of a fan. They are adapted to applying sprays over a large area.

d. Low pressure boom sprayers are designed to be driven over fields or large areas of turf, applying the pesticides in swaths to the crop. They are relatively inexpensive and light weight and can cover large areas rapidly.
12. Calibration is simply adjusting the application equipment output so that the desired rate of pesticide will be applied. Tell how you would calibrate a sprayer equipment.

a. To calibrate a sprayer first clean the nozzle, determine the type of pesticide to be sprayed and the distance to be covered.

b. To calibrate a sprayer, first measure the amount of pesticide, identify the pest, choose an appropriate sprayer equipment.

c. To calibrate a sprayer, first choose the speed, pumping pressure and nozzle to be used. Make a trial run with plain water over a measured area. After spraying, measure the amount of water it takes to refill the tank. If after spraying 1 acre it took 10 gallons of water to refill the tank, then the sprayer is applying the water at the rate of 10 gallons per acre.

d. To calibrate a sprayer, first make a trial run with the pesticide, then choose the pressure nozzle and determine the distance to be covered.
13. After applying pesticides against the target pest, an applicator found out after few days that some of the pests have developed resistance to the pesticide. What control measures would you suggest for reducing the resistance of the pests?

a. Calibrate equipment carefully. A small increase in dosage may mean severe effects on the insects. Increase the quantity of pesticide in the spray.

b. Use care in developing ground application and flight patterns. Spray while the insects are feeding and under favorable weather.

c. Be sure you hit the designated target. This will eliminate the resistance.

d. Rotate chemicals. Switch the products. Monitor fields that are nearby so that new problems can be detected as they are developing.

14. Develop a decision making model for determining the suitability of the application site for the success of your pesticide application. Which one of the following would best represent your model?

a. Type of space or surface to be treated, surface cleanliness; surface moisture; temperature, humidity, presence of direct sunlight, possibility of rain or watering; air movement. The above factors will influence the decision you make about the application site.

b. Type of pesticide to be treated, topography, acidity of the soil, soil tillage, permeability of the site, weeds surrounding the site, medical facilities near the site.

c. Both a and b.

d. None of the above.
15. Develop an evaluation question that will influence your decision of making safety one of your first concerns every time you handle pesticides. Which one of the following sets of questions would best represent your evaluation questions?

a. Have I read the label? How can I avoid exposure to pesticides? What personal protective equipment is needed? Is the equipment ready and safe? Have I instructed the handlers I supervise? Am I prepared for emergency? Are people and animals out of the area?

b. Have I selected an effective pesticide? Do I know the symptom of the pesticide? Is it economical to initiate control measures? Is chemical pesticide the only control measure? Is there a physician available in case of emergency?

c. Have I used all the available resources? Have I discussed this with my county agent? Did I understand what was taught in the pesticide training program?

d. Have I selected the right nozzle? Is the hand sprayer in good condition? Have identified the correct pest? Is the pesticide compatible?
16. Some solvents do not have to be listed in the ingredient statement, so you may not be able to choose a chemical resistant material on the basis of what is in the mixture. Which one of the following criteria would you use to know when a material is chemically resistant to the pesticide you are handling?

a. The material may change color, become soft or spongy; swell or bubble up; dissolve or become like jelly; crack or get holes; become sift or brittle.

b. The material may be very thick; water soluble or solvent dissolvable; flammable and dust permeable.

c. The material does not change color; does not become soft or spongy; does not swell or bubble up; does not crack or get hole; does not dissolve or become jelly.

d. All of the above.
17. Below is the protective clothing necessary for safe hazardous pesticides application (pesticide with label marked DANGER).
Analyze it in terms of the appropriateness and completeness. Choose one of the following analysis.

a. Coverall was used to reduce skin contamination. Wide brimmed hat was used to cover the hair. The skin about the head, eye and neck was well protected. The hand was protected with gloves, the feet with waterproof boots. The protective clothing was complete and appropriate for safe pesticide application.

b. The protective clothing was made up of long-legged trousers, short-sleeved shirts, shoes, socks impermeable gloves, goggles water permeable aprons. The protective clothing was complete and appropriate for liquid formulation only.

c. The protective clothing was made up of a water repellent, long-sleeved shirt, face shield. It was designed for prolonged exposure to spray or application in enclosed area.

d. The protective clothing was made up of water proof suit, water impermeable boots, water impermeable gloves, waterproof hood, face shield. It was complete and appropriate for all types of formulation.
18. Records of pesticide usage are important to help protect yourself and your investments. Some forms are for use in agricultural field applications and others are for use in keeping records of pesticide application in vegetables, fruits crops, livestock, property, and building. Below is a sample record form for animal treatments taken from a user's guide. Note any errors, any incomplete information and analyze it in terms of the appropriateness and completeness of the information to be kept. Which one of the following analyses would you choose?

---

**CHEMICAL USE RECORD**

Dairy Animals, Livestock, Poultry, and Animal Housing

---

<table>
<thead>
<tr>
<th>Animal</th>
<th>Name or Description of Chemical</th>
<th>Date of Last Treatment (Month/Day/Year)</th>
<th>Date of Next Treatment (Month/Day/Year)</th>
<th>Date of Next Treatment (Month/Day/Year)</th>
<th>Date of Next Treatment (Month/Day/Year)</th>
<th>Date of Next Treatment (Month/Day/Year)</th>
<th>Date of Next Treatment (Month/Day/Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Please turn over.
a. The form does not contain spaces for acreage treated, identification of treated area, ingredient statements. The form is incomplete and inappropriate.

b. The form does not contain the purpose for application, formulation of chemicals, stages of development of disease, method of application, and the temperature at the time of treatment. It is incomplete and not appropriate.

c. The form contains soil conditions (wet, dry, sand cloddy). It contains stages of development of insects and diseases, and effectiveness of treatment. It is complete and appropriate.

d. The form contains spaces for records of species of animals treated, material used and rate of application or dosage, date of first and final treatment, method of treatment, market class, special, and precautions. It is appropriate.
19. You have been asked to assess the damage potential from population of the potatohopper. The resources and methods available to you are:

Visual field checks
Monitoring weather fronts
Watching the number of hoppers around the light on your porch.
Using a sweep net.

Which method would you prefer to use to assess the damage and why?

a. Watching the number of hopper around the light on your porch. The number of hoppers will tell you the amount of damage they will do. Then you will know whether to control the hopper or not.

b. Using a sweep net. Using a sweep net to sample the field is the preferred and most reliable method for assessing action threshold.

c. Monitoring weather fronts. Monitoring weather fronts is a reliable means for predicting economic damage.

d. Visual field checks can prove if leafhoppers are present. If used prompt rescue treatment if "hopper burn" (wedge-shaped yellow of the tips) is present.

20. The table below shows the number of private applicators in Ohio by year holding valid certification as of September 30 of each year and the yearly investigations made by ODA pesticide regulation on suspected use problems.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of valid applicators</th>
<th>No. of cases investigated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>16,702</td>
<td>487</td>
</tr>
<tr>
<td>1988</td>
<td>17,630</td>
<td>285</td>
</tr>
<tr>
<td>1989</td>
<td>18,665</td>
<td>270</td>
</tr>
</tbody>
</table>

In 1987, a staff of ODA predicted that in the next three years, the number of private applicators holding Ohio valid certificate will increase greatly and there will be a great decrease in the number of cases to be investigated. Judging the effect of the training, do you see an increase in the number of applicators with valid
Ohio certificate and a decrease in the number of cases investigated? Why or why not?

a. There was an increase in the number of applicators with valid Ohio certificate. Comparing the number of cases to the number of applicators, there was no decrease in the number of cases investigated.

b. There was a decrease in the number of cases but no significant increase in the number of applicators holding valid certificate.

c. There was an increase in the number of applicators holding Ohio valid certificate and there was a reduction in the number of cases as revealed by the table.

d. The table showed no increase in the number of applicators holding Ohio valid certificate and there was no decrease in the number of cases investigated.
APPENDIX D

ATTITUDE AND DEMOGRAPHIC INSTRUMENT
Factors Related to the Learning of Participants in the Ohio Pesticide Private Applicators Instructional Program.

No_________ County______________

Strictly Confidential.

Section A. Attitude Toward Information given in the pesticide training Program. The following statements are related to the information provided in the pesticide training program. Indicate your agreement or disagreement with each of the statements. Use the following scale for each response:

SD = Strongly disagree.
D = Disagree.
A = Agree.
SA = Strongly Agree.

By using the techniques taught in the pesticide training program I can:

A. Correctly identify the pest to be controlled. SD D A SA

B. Control pest effectively on my farm. SD D A SA

C. Choose the correct pesticide formulation. SD D A SA

D. Properly mix pesticides. SD D A SA
E. Pick out important information on a typical pesticide label.  

F. Calibrate my application equipment to distribute the correct amount of pesticide at the correct rate.  

G. Distinguish among the toxicity categories of pesticides.  

H. Practice safety measures to prevent injury to myself, the environment and others when using pesticides.  

I. Properly store leftover pesticides  

J. Effectively follow first aid procedures in case of an accident.  

K. Understand the laws regulating pesticide use.  

L. I do not believe that the techniques taught in the pesticide training program were better than the ones I have been using.  

M. My pesticide application practices are fine and I do not need to change.
Section B. Attitude Toward the Training Program. Indicate your agreement or disagreement with each of these statements about the pesticide training program. Use the following scale for each response:

SD = Strongly disagree
D = Disagree
A = Agree
SA = Strongly Agree

A. I am happy to have participated in the pesticide training program. SD D A SA

B. The program held my interest. SD D A SA

C. When the training began I was very interested, but after sometime, I became tired and bored. SD D A SA

D. The training program was very helpful to me. SD D A SA

E. The training program should be eliminated. SD D A SA

F. The training program should be continued. SD D A SA
G. The training program should be improved.

H. The training program was understandable.

I. The training program was well taught by the instructors.

J. The topics were taught at too high level of understanding.

K. The facilities for the training program limited participation.

L. The topics taught were applicable to the majority of the participants.

M. The courses in the training program were well organized.
Section C. Attitude toward methods of instruction.

The following is a list of instructional methods that may have been used in the pesticide training program. In your opinion, how important is each of the instructional methods? Please rate each method’s importance to you by circling one of the numbers following each method.

Here is an example:

<table>
<thead>
<tr>
<th>Method</th>
<th>Not Important</th>
<th>Very Important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 (5) 6 7</td>
<td></td>
</tr>
</tbody>
</table>

By circling 5, this individual indicated that this method is important.

<table>
<thead>
<tr>
<th>Method</th>
<th>Not Important</th>
<th>Very Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture meeting</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Video tape</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Manual</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Demonstration</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Slides/Transparences</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Agents guide</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>
Section D  General Information  The following questions seek
general information about your background and your farm
operation. Please circle one response for each question.

1. What is the highest level of education you completed?
   A. Some grade school (1-8).
   B. Some high school grade (9-12).
   C. Completed high school or equivalent.
   D. Some college.
   E. Completed a four year college degree.
   F. Completed a graduate or professional degree.

2. What is your present age?
   C. 31-40.       F. 61-Above.

3. In the past year, how many days did you work off-farm at
   least 4 hrs per day. Include work at a non farm job,
business or on someone else’s farm. Do not include
   exchange farm work.
   A. None.       D. 100-149.
   B. 1-49.      E. 150-199.
APPENDIX E

INTERVIEW SCHEDULE
INTERVIEW SCHEDULE

This study also involves learning about how extension agents teach the participants in the pesticide training program. I have developed some questions which will help us stay on target. Please respond to each question to the best of your knowledge. Feel free to use your handouts/notes prepared for the program while answering the questions. Also let me know, if you need to stop the tape at any point of time during the interview. I will stop the tape and begin when you are ready. Let us begin.

1. Will any resource person be involved in teaching the program?

2. What is the purpose of the program?
   (probe educational objectives and behavioral changes expected in participants: For example, after the completion of this program the participants will be able to....)
3. During your teaching will you ask questions?
   YES/NO
   If yes, probe by asking:
   a. What type of questions will you ask?
   b. Will you ask different questions at different times?
      If so, how will they differ? Give examples.
      If no, probe by asking:
      a. What methods will you use to ascertain whether or not your participants were learning?
         Why did you choose not to ask questions?

4. What kinds of learning experiences/activities (planned or unplanned) will you use to teach your participants? For example, discussion groups, demonstration, hands-on activities, etc.
   a. Probe by asking them to describe the activity.
   b. Probe to see if any activity will be provided for the participants to put the pieces of information together and come up with new ideas or solutions to a problems?
   c. Probe to see if any activity will be provided to aid participants in making a judgement or critical evaluation.

5. What materials will you use to present the program? For example, slides, slides, films, lecture, overhead projector, etc.
6. Did you develop any lesson plan for presenting this program?
   If yes, ask to see the plan.
   If no, ask why not?

7. Will an evaluation be conducted immediately after the program or planned as a follow-up?

8. Is there anything else that I have not asked regarding this program that you would like to share with me?

9. Any questions that I can answer for you?
Nov. 18, 1992.

Dear Educator,

I am a graduate student at The Ohio State University and I am conducting a study on "Factors Related to the Learning of Participants in the Ohio Pesticide Private Applicators Instructional Program". You have been selected as an expert on cognitive as it relates to teaching, or the pesticide applicator training program. With instrument #1, we are trying to measure the attitudes of participants toward the training program. With instrument #2, we are attempting to measure how much students have learned in the pesticide training instruction.

Please determine the adequacy, clarity, and appropriateness of instrument #1 by checking the content and format of each statement on the instrument. For instrument #2, review the items for their validity in measuring the technical content for the pesticide applicator training program. Please see "Issues Addressed in Current Federal Regulations on Private Application Competency". Secondly, indicate your judgement as to whether or not each item is correctly categorized by level of cognition required. Please see my headings and "Levels of Cognitive Learning" developed by Newcomb and Trefz. You should re-write any item on the instrument where you believe should be rewarded.

Your response is very important to the success of this study. Please return the completed questionnaire in the self-addressed envelope before November 30, 1992.

Thanks for your cooperation.

Yours Sincerely,

Daniel Okoro.

Larry E. Miller
March 10, 1993

We are conducting a study on "Factors Related to the Learning of Participants in the Ohio Pesticide Private Applicators Instructional Program". We will measure the attitudes of participants toward the training program and how much students have learned in the pesticide training instruction. Permission to conduct the study has been approved by The Ohio State University Extension.

Dr. Miller had already talked to you at the pesticide applicators conference about the importance of the study and he requested your help and permission to allow your students to take the pretest and posttest. We would need you to give us about 20 minutes for the pretest at the start of the meeting and 25 minutes for the posttest and attitude responses at the end of the meeting.

We would like to attend your training session on March 25, 1993 to collect these data. We will call you a few days before the meeting to remind you of our coming.

Your help is very important to the success of this study and if you have any questions please contact me at 292-1354, or in the evening at 848-9491.

Thanks for your cooperation.

Sincerely yours,

Daniel Okoro

Larry E. Miller

CC: District Supervisor
    Don Pritchard
    Keith Smith
    Acie Waldron
    Joan Kick-Raack
APPENDIX G

LEVELS OF COGNITION

NEWCOMB-TREFZ MODEL
COGNITION LEVELS OF LEARNING

A. Remembering

1. Involves the ability to memorize and recall:
   a. simple, concrete facts, definition, dates etc.
   b. means of classifying or categorizing these facts, complex, abstract theories or generalizations

2. No understanding of the concepts or principles of the information is required

B. Processing

1. Involves the use of known facts, principles, theories, etc.

2. Uses included in this level are:
   a. comprehension of the meaning and intent of the material
   b. application of understood information to new and unique situations
   c. analysis of the information or situation to increase understanding and facilitates problem solving.

C. Creating

1. Involves the ability to combine pieces of information in a form that is new to the student

2. Provides the opportunity for independent thinking; self expression.

3. Generally involves the development of some type of product:
   a. a communication that expresses the unique ideas, feelings, and experiences of the student.

4. This product can be used to inform, describe, persuade, impress, or entertain.
D. Evaluating

1. Involves the ability to make a judgement or critical evaluation, for a given set of information, that is based on a standard or specific criteria.

2. The judgement/evaluation can be based on:
   a. internal evidence—assessing the accuracy, consistency, and logic of the material.
   b. external criteria to judge or evaluate a particular situation or document.

3. The criteria used in the evaluation can be either from established standards or those determined by the student.
APPENDIX H

TAXONOMY BASED VOCABULARY LIST

NEWCOMB and TREFZ MODEL
<table>
<thead>
<tr>
<th>Remembering</th>
<th>Processing</th>
<th>Creating</th>
<th>Evaluating</th>
</tr>
</thead>
<tbody>
<tr>
<td>acquire</td>
<td>analyze</td>
<td>infer</td>
<td>combine</td>
</tr>
<tr>
<td>cite</td>
<td>apply</td>
<td>interpolate</td>
<td>compose</td>
</tr>
<tr>
<td>define</td>
<td>associate</td>
<td>interpret</td>
<td>constitute</td>
</tr>
<tr>
<td>identify</td>
<td>categorize</td>
<td>outline</td>
<td>construct</td>
</tr>
<tr>
<td>label</td>
<td>change</td>
<td>paraphrase</td>
<td>create</td>
</tr>
<tr>
<td>list</td>
<td>choose</td>
<td>point out</td>
<td>derive</td>
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<tr>
<td>name</td>
<td>classify</td>
<td>predict</td>
<td>design</td>
</tr>
<tr>
<td>recall</td>
<td>compare</td>
<td>prepare</td>
<td>develop</td>
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<td>rearrange</td>
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<td>recognize</td>
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<td>convert</td>
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<td>formulate</td>
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<td>originate</td>
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<td>use</td>
<td>tell</td>
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<td>extrapolate</td>
<td>use</td>
<td>transmit</td>
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<td>use</td>
<td>write</td>
</tr>
<tr>
<td></td>
<td>illustrate</td>
<td>use</td>
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</tbody>
</table>

Adapted from:
Chamberlin and Kelly (1981), Clegg (1986); Hall (1983)
APPENDIX I

CHARACTERISTICS AND EXAMPLES OF QUESTIONS

NEWCOMB and TREFZ MODEL
CHARACTERISTICS AND EXAMPLES OF QUESTIONS AT THE LEVELS OF LEARNING

Remembering

A. Characteristics of the Level

1. The student would be able to offer the answer out of his/her memory; he/she is not required to understand, compare, relate, or make any independent reasoning in providing the answer.

2. A question at this level is worded in a way identical to the way the information was originally learned. Items should not use terms which are new to the student.

3. Any question, regardless of its presumed complexity, which can be answered through mere recall of information previously discussed in class or in the text should be categorized as knowledge level question.

B. Representative Question Types and sample Questions

1. Completion item

   a. Example-The preferred inventory valuation method for corn in storage on cash grain farm is ____________.

2. Request for definition, statement of principle, methods or steps of a model.

   Example - List the steps in pork slaughter from stunning through hanging of the carcass.

3. Choice questions (such as multiple choice, true/false, matching, where the student selects from a set of given alternatives.

   Example - A firm's ability to pay all obligations if assets were liquidated is measure by: (1) liquidity; (2) solvency; (3) profitability; (4) financial efficiency and activity.

PROCESSING

A. Characteristics of the Level
Students must be able to:

1. translate ideas or concepts into their own words or inform useful to them in solving the problem,

2. select an approach (out of several possibilities) to solve a problem or situation that is new to the student;

3. identify, classify, discriminate, or relate particular qualities or characteristics of the material.

The material used in testing at this level should either be new to the student, or be different from that used in instruction, but with similar characteristics in terms of words used, content, and complexity.

B. Representative Question Type and Sample Questions

1. Predict what will happen in new situations using appropriate principles or criteria.
   a. Example - If a 6-inch pulley on output shaft of the motor drives a 3.5-inch pulley on the input shaft of the pumps through a V-belt drive and the motor is turning at 1725 rpm, what is the torque (ft. lbs.) on the input shaft of the pump?

2. select an approach (from several possibilities) to deal with a problem or explain a concept.
   a. Example - which method of cooking would be most desirable for a muscle region in which fibrous connective tissue content was high? (a) roasting; (b) broiling; (c) braising; (d) frying

3. Use established criteria (such as cause/effect or sequence) to classify the content of materials or distinguish a pattern, order, or arrangement.
   a. Example - which of the following processing procedures could lead to trouble when making a better-type sausage item? (a) add the salt early in the chopping procedures; (b) add regular pork trimmings first, leaving boneless bull beef for the last 1/3 of the chopping procedure; (c) add ice water so as to have 10% more moisture in the finished product that was determined by the normal moisture to protein ration; (d) cook to an internal temperature of 155 degrees;
CREATING

A. Characteristics of the Level

1. The student may identify the task or problem for him/herself, or at least have freedom in interpreting it.

2. The student may have the option to attack the problem with a variety of references or other materials. Problems at the creating level are often in open-book examinations.

B. Representative Questions Type and Sample Questions

1. The ability to ask the right question when faced with a problem situation.

   a. Example - You have two dwarf apple trees which were planted at the same time and were acquired from the same grower. The trees are now seven years old. One tree has flowered and set fruit regularly; the other tree has yet to flower. Identify questions which need to be pursued in attempting to design a problem solution.

2. Plan an appropriate course of action to a given situation.

   a. Example - You have recently been approached by an earthworm producer to help him design an "earthworm harvester." Earthworms are produced in trays of moist compost similar in earthworms must be separated from the compost. Propose a design concept for the earthworm harvester showing sketches, drawings, etc. with sufficient explanation that our earthworm producer (a farmer for 10 years with a high school education) can understand. Prepare a list of information needed to complete your design. Design criteria: (1) worms must be harvested alive and healthy; (2) at least 95% of the worms are to be recovered; (3) less than 1% of the compost is to be left with the worms; (4) compost is to be saved because it has value as a soil amendment; (5) maximum cost is $10,000 (may be willing to increase for a really promising idea); (6) must be
able to harvest one 1'x4'x6' tray in 15 minutes. Additional information well known to fishermen, little boys, and earthworms: (1) earthworms come to surface of soil during a heavy rain; (2) earthworms go underground if bright light is shown on them; (3) earthworms come to surface if electric current is introduced into wet soil.

EVALUATING

A. Characteristics of the Level

1. Make judgements about the worth or value of an idea, solution, method, etc, using a set of criteria as a basis for the judgement

2. The problem situation or material to be evaluated should be available to the student as they make the evaluation, and they should be able to refer to it as they attempt to answer the evaluative questions or problems.

B. Representative Question Type and Sample Questions

1. Recognize the extent to which particular details of a document are accurate, precise, or carefully done.
   
a. Example - From the enclosed sample pages from a farm record book, note any errors, any incomplete information, and analyze in terms of the appropriateness and completeness of the information.

2. Recognize the ways in which the parts of a work fit together in terms of consistency, order, and organization
   
a. Example - Analyze the attached landscape to plan for a front entrance and suggest modifications needed, if any.

3. Identify the criteria on which a judgement has been based for a particular situation.
   
a. Example - The animals shown in the slide provided have been placed in carcass evaluation in the following order. Compare the slide of the live animals and the
carcass slide and list those characteristics you feel were considered in making the decision. Which characteristics were particularly relevant in making this placing?

4. Analyze and evaluate a new situation or set of information by relating it to another situation that was previously studied in the course.

a. Example - Based on what was studied in class for determining feed rations for cattle herd, what suggestions would you make to herdsman in terms of the following ration for the following herd specification? (Specifics of ration and herd would be included here.)

5. Establish his/her own criteria to judge a particular situation.

a. Example - Develop a decision making model for determining the efficacy of using bio-technology procedures to increase milk production.
APPENDIX J

1992 OHIO PESTICIDE APPLICATOR CONFERENCES
1992 OHIO PESTICIDE APPLICATOR CONFERENCES
SPONSORED BY
THE OHIO COOPERATIVE EXTENSION SERVICE AND THE OHIO
DEPARTMENT OF AGRICULTURE

DATES:
NOV. 19 Strongsville Michaud's, 19808 Pearl Road
NOV. 20 Perrysburg, Holiday Inn French Quarters
10630 Fremont Pike
DEC. 15 Dayton, Dayton Convention Center, 22 E.
5th Street
DEC. 16 Columbus, Ramada University Hotel, 3110
Olentangy River Rd.

DESCRIPTION: This conference provides updated pesticide
information and is designed for individuals
seeking continuing or recertification
training.
The program includes:
Opportunity to complete requirements in one
day. Recertification credit offered in 34
categories and core.
Testing facilities if you wish to add
categories.
Proceedings manual for for each participant

1992 CONFERENCE SCHEDULE ATTENDED

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<tr>
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APPENDIX K

PANEL OF EXPERTS
PANEL OF EXPERTS

1. Dr. L. H. Newcomb: Professor, Department of Agricultural Education and Associate Dean, College of Agriculture, OSU.

2. Dr. Jamie Cano: Associate Professor, Department of Agricultural Education, OSU.


4. Steve Prochaska: County Extension Agent/CNRD Crawford County, Ohio

5. Dr. Acie Waldron: Pesticide Coordinator, The Ohio State University.
APPENDIX L

STEPWISE REGRESSION ANALYSIS OF ATTITUDES AND SELECTED DEMOGRAPHIC VARIABLES ON ACHIEVEMENT.
Stepwise Regression Analysis of Attitudes and Selected Demographic variables on Learning (Achievement) of Participants on the PAT Program

Listwise Deletion of Missing Data

Equation Number 1   Dependent Variable..   Achievement
Beginning Block Number  1   Method:   Stepwise
End Block Number  1   PIN =   .050 Limits reached.
No variable entered/removed for this block.
REFERENCES CITED


McCracken, J. D. The Use Of Correlational and Regression Analysis in Agricultural Education Research. Paper presented as the invited address at the National Agricultural Education Research Meeting, Los Angeles, CA, December 6, 1991.

McCracken, J. D. (1990) Class notes for Agricultural Education 886, Research Design. Unpublished manuscript, The Ohio State University, Columbus.


