An identification and assessment of Extension educational delivery systems for training of private pesticide applicators

John Lewis Creswell
Iowa State University

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An identification and assessment of Extension educational delivery systems for training of private pesticide applicators

Creswell, John Lewis, Ph.D.

Iowa State University, 1990
An identification and assessment of Extension educational delivery systems for training of private pesticide applicators

by

John Lewis Creswell

A Dissertation Submitted to the
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Iowa State University
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1990
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CHAPTER 1. INTRODUCTION

People have become very concerned about pesticides, how they have been used and their potential to damage human health, wildlife, and the environment. Since the early 1970s, state cooperative Extension systems have provided educational programming on the safe handling, use, and storage of pesticides. This educational programming was initiated by the Federal Insecticide, Fungicide, and Rodenticide Act, as amended in 1972, which authorized the Administrator of the United States Environmental Protection Agency to enter into cooperative agreements with states to:

1. Delegate the authority to cooperate in the enforcement of this Act, and to assist states in implementing cooperative enforcement programs.

2. Assist state agencies in developing and administering state programs for training and certification of pesticide applicators.

3. Enter into contracts with Federal or state agencies for the purpose of encouraging the training of certified pesticide applicators.

4. Utilize the services (in cooperation with the United States Secretary of Agriculture) of state Cooperative Extension Services, for informing farmers of accepted pesticide uses and other regulations (Public Law 92-516, 1972).
The initial intent of this training and education program was to provide information on pesticides that would enable participants to apply and handle them correctly and safely. But these programs quickly became sessions to provide information for passing mandatory certification tests (Pearson, 1987). Training was primarily through the use of an illustrated lecture-discussion format.

Some individuals and organizations have questioned just how well these programs were training private applicators. Surveys indicated that training programs were too repetitive, and people were getting tired of them (Mueller, 1988a). Agricultural officials and state legislators have been concerned that farmers, although certified, had received inadequate training relative to the use of agricultural chemicals listed as being restricted by the United States Environmental Protection Agency (Fruhling, 1987). In addition, budget cuts crippled attempts to improve certification and training programs. Extension needed funding support if it was to deliver effective educational programs (Mueller, 1988b).

Extension educational delivery methods adopted following the passage of the Smith-Lever Act in 1914 have always relied on an approach where the learner observed a demonstration or tried out an activity. Extension has been the organization best equipped to address the non-formal educational problems of production agriculture and rural living (Hildreth & Armbruster, 1981). Extension's mission has been to disseminate and encourage the application of research-based knowledge. Tried and proven Extension program delivery systems over the years
have been the demonstration, the bulletin, use of penalty mail, and the meeting (Diezsin, 1981).

Agricultural research and Extension have played a major role in increasing the productivity of American agriculture. However, Brown (1981) raised a question with respect to Extension's effectiveness in future years. The National Agricultural Research and Extension Users Advisory Board recommended, in a March, 1980, report to the President and Congress, that improved knowledge and technology transfer systems be developed by Extension.

A survey of Iowa adult educators by Martin and Omer (1988) indicated that the predominant instructional strategy was the lecture-discussion method, using overhead projectors and slide projectors as instructional tools. Extension studies have shown the effectiveness of using more than one teaching method to bring about desired behavioral change. Extension educators and administrators wonder how many Extension agents have used and are currently using a variety of teaching methods in their educational programming (Cole, 1981).

Extension teaching methods have tended to focus more on the content of the course than on the methodology used in the course. Inservice training and support materials for agents usually have focused on what the agent was to teach, with little attention spent on how to teach it. Since Extension agents traditionally have been hired because of their expertise in a technical subject-matter area, it should not be assumed that they have been prepared to fill a teaching role (Cole, 1981). For example, most state specialists hired since the 1960s have received
doctorates in a subject matter area, usually agriculturally related, and have had little or no field experience. They have been inadequately prepared to meet the challenges and responsibilities of a state Extension specialist (Brown, 1981).

Statement of the Problem

Successful adult educators employ a variety of instructional techniques and strategies, depending on program content, expected outcomes, the learning environment, and available educational resources. Instructional techniques and strategies often evolve naturally from what has to be taught (Knox, 1987).

No one teaching technique is suited to every situation. But how many Extension educators have ventured beyond use of a few tried and true teaching methods? How many Extension educators first analyze a teaching situation before selecting the appropriate teaching method or methods? Extension studies have shown that increasing the teaching methods used in a program will increase the desired behavioral change of learners. A teacher must structure a learning situation so that students can learn (Cole, 1981).

Many Extension programs - including private pesticide applicator training - have been evaluated on subject matter content. Very few Extension programs have been evaluated or studied with respect to teaching techniques and strategies. The instructional techniques and strategies used in program delivery should receive the same
consideration by the Extension worker as does the selection of subject matter content. The process should be as critical as the product of education and training.

Purpose and Objectives of the Study

The purpose of this study was to identify and assess the educational delivery systems used by county Extension agriculturalists in private pesticide applicator training.

With respect to pesticide applicator training, the objectives of this study were to:

1. Identify demographic characteristics of county agricultural Extension professionals.
2. Identify perceptions held by county agricultural Extension professionals regarding principles of teaching-learning.
3. Identify teaching methods and instructional tools used and perceived to be effective by county agricultural Extension professionals in conducting pesticide training programs.
4. Identify perceptions held by county agricultural Extension professionals regarding the pesticide training program.
5. Compare perceptions, use of instructional methods/tools based on selected demographic data.
Limitations of the Study

Due to financial considerations, this study was limited within the twelve state North Central Region to county Extension agriculturalists in Iowa, Nebraska, North Dakota, and Wisconsin.

Need for the Study

With the unparalleled explosion of information through electronic transfer, production supply firms and agricultural cooperatives have employed many professional field personnel. These individuals have supplied farmers with technical information and assistance. Agricultural consultants have provided similar services. Information/technology transfer once was the exclusive domain of the county Extension agent. These outside resources have not eliminated the role of county Extension agents, but certainly have supplemented and partially replaced them (Hildreth & Armbruster, 1981).

Naisbitt (1984) observed that people have been swamped with information, but starved for knowledge. Extension programs need to be action-oriented and must provide practical, adaptable techniques. People want to be assured that they will personally benefit from participation in extension programs. Extension workers need to enhance their abilities as professional educators. They need to learn how to set educational objectives, gather and interpret data, design appropriate learning
situations, use a variety of teaching methods, develop lesson plans, and employ evaluation techniques (Astroth & Robbins, 1987).

Implications and Educational Significance

This study was initiated to identify and assess the educational delivery systems used by county Extension agriculturalists in Iowa, Nebraska, North Dakota, and Wisconsin to train private pesticide applicators. Information learned in this study could be extended to include other foundation and issues-oriented Extension education programs in the twelve state North Central Region.

Operational Definitions

The following terms were defined to properly focus the study.

Commercial pesticide applicator: A person who applies a pesticide (restricted or general use) for compensation.

Cooperative Extension Service: The agency given the responsibility of training commercial and private pesticide applicators.

Department of Agriculture: The state agency normally responsible for testing and certifying private pesticide applicators and enforcing laws and regulations passed by state and national legislatures.

Delivery system: A systematic procedure in which educational programs are conceived, planned, organized, presented, and evaluated based
on clientele needs, situational constraints, technical inputs, and available learning process technologies.

Environment: The sum total of all living and non-living external influences experienced by an organism.

Environmental Protection Agency: The agency charged with the responsibility of protecting the nation's environment.

Formal education: A learning experience leading to a diploma or certificate.

General use pesticide: A pesticide that will not harm humans or the environment when used according to label directions.

Learning: Knowledge or skills acquired by an individual through instruction, study, or experience.

Non-formal education: Self-directed learning that does not lead to a diploma or certificate.

Pest: Any living organism that competes with humans for food and fiber, or can be harmful to human health.

Pesticide: A chemical used to directly control pest populations, or to prevent or reduce pest damage.

Pesticide education: Teaching beyond what is required for the producer to pass a pesticide certification examination.

Pesticide registration: The registration of pesticides and pesticide uses by the Environmental Protection Agency, or by the state Department of Agriculture.
Pesticide training: The acquisition of information necessary for the producer to take and successfully pass a pesticide certification examination.

Principles of teaching-learning: Tenets used by educators to facilitate the learning process.

Private pesticide applicator: A producer who applies any restricted use pesticide for the production of an agricultural commodity on property owned or rented by themselves or their employers, or on the property of another person with whom they trade services.

Producer: A farmer (tenant, employee, or landowner).

Public pesticide applicator: An individual employed by a government agency who applies pesticides (general or restricted) in the normal course of duty.

Restricted use pesticide: A pesticide that poses a threat to humans or the environment.

Smith-Lever Act of 1914: Authorized the United States Department of Agriculture to provide, through the land-grant colleges, instruction and practical demonstrations to help people identify and solve their farm, home, and community problems.

State Pesticide Act: Published regulations for the sale and application of pesticides.

Teaching: The art and practice of instructing others by precept, example, or experience.

Teaching-learning process: The need for both teacher and learner to interact in learning activities with measurable objectives - through
instruction, inquiry and performance - and to receive constructive evaluation.

Teaching or instructional methods: Various strategies used in facilitating the teaching-learning process.

Teaching or instructional tools: Equipment used in facilitating the teaching-learning process.
CHAPTER II. REVIEW OF THE LITERATURE

The purpose of this study was to identify and assess the educational delivery systems used by county Extension agriculturalists in private pesticide applicator training. To increase understanding and provide a theoretical basis of why county Extension agriculturalists use/prefer certain educational delivery systems, literature related to teaching adult learners was reviewed.

The review of the literature is divided into four major subheadings:
1. History of Adult Teaching-Learning
2. Extension Teaching Methodology
3. Extension Program Evaluation
4. Summary of Review of the Literature

History of Adult Teaching-Learning

The taxonomies of educational objectives developed by Bloom et al. (1971) divided educational objectives into three major domains: the cognitive (thinking), the affective (feeling), and the psychomotor (physical). These domains have proven to be applicable in developing educational programs for both youth and adult audiences.

Knowles (1970) was the first educator to define the difference between how children learn as opposed to how adults learn. Pedagogy is the science of teaching children to learn. Andragogy concerns itself with
the facilitating process of helping adults learn. The four crucial qualities that differentiate adult learners from child learners are:

1. An adult's self-concept moves from dependence towards self-direction.
2. An adult accumulates a growing reservoir of experience that becomes a resource for life-long learning.
3. An adult's readiness to learn becomes oriented increasingly to the developmental tasks of social roles.
4. An adult's time perspective changes from one of postponed application of knowledge to immediacy of application.

A person's orientation toward learning, over time, shifts from learning to increase knowledge to learning to solve a problem. A person is considered to be an adult when he/she:

1. Performs social roles typically assigned by society to those considered adults (worker, spouse, parent, soldier, etc.).
2. Perceives himself/herself to be essentially responsible for his/her own life.

Knowles (1980) made four assumptions of andragogy. They are:

1. Adults both desire and enact a tendency toward self-directedness as they mature.
2. An adult's experiences are a rich resource for learning.
3. Adults are aware of specific learning needs generated by real life tasks or problems.
4. Adults are competency-based learners in that they wish to apply newly acquired skills or knowledge to their immediate circumstances.

Mouton and Blake (1984) defined synergogy as a systematic approach to learning in which members of small teams learn from one another through structured interactions. Synergogy provided an alternative to pedagogy and andragogy by eliminating the teacher authority role in pedagogic settings and excessive reliance on the student already knowing what he/she needed to know in andragogic settings. Synergogy differs from pedagogic and andragogic teaching methods by:

1. Replacing authority figures with learning designs and instruments managed by a learning administrator.

2. Enabling learners to become proactive participants who exercise responsibility for their own learning.

3. Applying the concept of synergy, in which the learning gain resulting from teamwork exceeds the gain made by an individual learning alone.

4. Using learners' colleague affiliations to provide motivation for learning.

Three major forms of learning are differentiated: (1) the acquisition of knowledge (facts, principles, theorems, propositions, etc.), (2) the development of skills (ability to perform some set of operations in a competent manner), and (3) the enhancement of attitudes (patterns of individual responses that reflect values, judgment, and feelings). Four synergogic designs are applied to these three forms of learning:
1. Team Effectiveness Design (TED), where each of a team's learners assesses his/her knowledge prior to team discussion.

2. Team-Member Teaching Design (TMTD), where participants are responsible for learning an assigned portion of the subject matter and teaching it to the others.

3. Performance Judging Design (PJD), where learners acquire practical skills.

4. Clarifying Attitudes Design (CAD), where learners discover whether their attitudes have a sound basis in available facts, data, and logic.

Learning abilities and styles change gradually through life. Performance in tasks that benefit from accumulated experience - vocabulary, general information, fluency in dealing with ideas - increases with age. This product is called crystallized intelligence. Fluid intelligence - the ability to store strings of numbers and facts in short-term memory, react quickly, see spatial relations, and do abstract reasoning - is normally easier for younger people (Cattell, 1963).

Smith (1982) stated that learning: (1) occurs throughout life, (2) is personal, (3) involves change, (4) is partially a function of human development, (5) pertains to experience, and (6) is partially intuitive. Adult learners also exhibit four essential characteristics. These characteristics are:

1. Adults have multiple roles and responsibilities.

2. Adults have accumulated many life experiences.
3. Adults pass through a number of developmental phases in the physical, psychological, and social spheres.

4. Adults experience anxiety and ambivalence in their orientation to learning.

Life-long learning is necessary for anyone, young or old, who has to live with the escalating pace of change. Cross (1981) stated that adults are goal-oriented, pragmatic learners. Educators have an obligation to facilitate life-long learning by utilizing the best knowledge and teaching techniques that are available. Most adult learners are interested primarily in non-credit learning options, or in some kind of certificate that increases their value to employers. Adults who lack the basic skills and motivation to learn are severely handicapped in obtaining the necessities of life, and in adding any measure of personal satisfaction and enjoyment to their lives.

Knox (1987) stated that the essence of helping adults learn occurs in the teaching-learning transaction. The satisfaction and knowledge gained from the teaching-learning experience depends on use of teaching methods such as; (1) effective use of questions and examples, (2) provision for practice opportunities, (3) sequence of activities for orderly progression, (4) satisfactory pacing, (5) positive reinforcement, and (6) program evaluation that provides effective feedback for both the teacher and the learner. Farquharson (1978) stated that the opportunity to teach others may be a preferred way for the teacher to teach him/herself. Wesley (1984) noted that teaching and learning is a communication process - a two-way dialogue which changes both the teacher and the
learner. Weston and Cranton (1986) defined "teaching method" as the vehicle or technique for instructor-student communication. This technique can be; (1) instructor-centered, (2) interactive, (3) individualized, or (4) experiential. In utilizing instructor-centered methods of teaching (lecture, questioning, and demonstration), the teacher conveys information to a group of students. Communication is mostly one way and student response is normally passive. Interactive teaching methods (discussions, peer-teaching, and group projects) work best with small classes and take more time to plan. Learning is facilitated by active student participation. Individualized teaching methods (programmed instruction, modularized instruction, independent projects, and computerized instruction) allow students to work with prepared teaching materials at their own speed. Experiential teaching methods (field experience, laboratory experience, role playing, simulations, and drill) allow learning to take place outside of the classroom.

The two distinguishing characteristics of adult learning are: (1) the adult's autonomy of direction in the act of learning and, (2) the use of personal experience as a learning resource (Brookfield, 1987). It is naïve to assume that learning is being facilitated simply because adults are under the direction of a teacher. A mass lecture to an adult audience in which there is no opportunity for discussion, questioning, exchange of differing viewpoints, or an attempt to link the learners' experiences with the topic under discussion is poor teaching practice. Learning does not
automatically occur simply because adults are brought together in a classroom setting.

Brookfield (1987) listed six principles of effective practice in facilitating learning. They are:

1. Participation in learning is voluntary.
2. Effective practice is characterized by a respect among participants for each other's self-worth.
3. Facilitation is collaborative.
4. Praxis (practice, rather than theory) is placed at the heart of effective facilitation.
5. Facilitation aims to foster in adults a spirit of critical reflection.
6. The aim of facilitation is the nurturing of self-directed, empowered adults.

Good facilitation is characterized by a respect for the uniqueness, self-worth, and separateness of each participant. The development of powers of critical reflection is central to the effective facilitation of learning.

Wlodkowski (1988) listed five critical educational assumptions for helping adults want to learn. They are:

1. People are always motivated.
2. People are responsible for their own motivation.
3. If anything can be learned, it can be learned in a motivating manner.
4. There is no one best way to instruct.
5. Every instructional plan needs a motivational plan.
Knox (1987) stated that adults vary in their approach and use of learning activities. The characteristics and preferred way in which an adult engages in learning activities is called "learning style". Intelligence, personality, age, formal education, and previous specialized experience contribute to the great variety of learning styles within the adult population.

**Extension Teaching Methodology**

Extension professionals were sometimes called change agents, because their purpose was to help producers apply new technology, newly discovered methods, and new inventions to their farming enterprise. Producers could then raise more crops and livestock, improve their standard of living, and provide more food for non-farm families (Lionberger & Gwin, 1982). Extension educational delivery methods relied on an approach whereby the learner observes a demonstration or tries out an activity. Extension was the organization best equipped to attack non-formal educational problems of production agriculture and rural living. There was a close interrelationship of farmers and rural residents with the Extension service (Hildreth & Armbruster, 1981). Tried and proven Extension program delivery methods over the years have been the demonstration, the Extension bulletin, use of penalty mail, and the "meeting." The 1980s has introduced a new program delivery tool - the computer (Diesslin, 1981).
Four guiding principles were formulated by Astroth and Robbins (1987) about the Extension system. They are:

1. It is an educational organization.
2. It is cooperatively organized with links at the federal, state, and local levels.
3. It is people-oriented.
4. It is problem-oriented.

The unparalleled growth of information delivery has given production supply firms and agricultural cooperatives the ability to supply farmers with technical information and assistance. An increasing number of agricultural consultants also provide these services. This information delivery approach once was the exclusive domain of the county Extension agent. Some farmers obtain information directly from agricultural experiment stations and other scientific sources, and thereby "by-pass" the county Extension agent. To survive, Extension should retrain its staff, redefine its audience, and improve its program delivery methods (Hildreth & Armbruster, 1981).

Funding to meet program demands has been inadequate, and the need for program delivery innovations has grown faster than the necessary support funding. To assure a high quality program, some educational programs should be dropped. The typical Extension worker, however, seldom drops a program (Holt, 1981).

Martin (1987) surveyed the educational program needs of Iowa young and adult farmers and found that:
1. Farmers were highly educated and were interested in more education.

2. Farmers rated adult educational programs fairly high in quality.

3. Farmers placed a very high priority on educational programs that addressed marketing, credit, and financial planning.

4. Farmers rated non-traditional program areas fairly low on interest and quality scales.

5. Farmers primarily rely on magazines, friends, neighbors, other farmers, and radio for information.

A study of young Iowa farmers involved in agricultural Extension programs by Martin and Omer (1988) indicated that three Cooperative Extension Service planning activities received high ratings. They were:

1. Analyze the farming community situation.

2. Understand and provide educational programs to meet educational needs.

3. Plan and prepare educational activities.

Seventy percent of those surveyed indicated that they were satisfied or very satisfied with services and information provided by the Iowa Cooperative Extension Service. Based upon the results of this study, the following recommendations were made:

1. Extension program planning should be approached primarily from the perspective of the clientele served, and secondarily from a subject matter point of view.
2. The Iowa Cooperative Extension Service should increase the involvement of young farmers in planning and conducting educational programs.

3. Extension professionals, young farmers, and Iowa Young Farmers Educational Association (IYFEA) leaders should identify and prioritize educational needs.

4. Educational programs should be planned and/or revised for present and future young farmers to emphasize the educational topics with the highest priority.

5. The differences of sex, age, and income should be considered when planning and conducting educational programs for young farmers.

6. Local meetings, county meetings, and newspaper articles are methods that should be used in the planning of educational programs for young farmers.

Cole (1981) identified three general classifications of Extension teaching methods. They are:

1. Individual contact.
2. Group contact.

The first two involve personal contact and interaction between teacher and learner. Mass media reaches more learners, but the contact is impersonal.

A study by Martin and Omer (1988) showed that the lecture-discussion method was the predominated instructional strategy used by
Extension professionals and post-secondary vocational-technical agriculture instructors in Iowa. The overhead projector and slide projector were the instructional tools most often used. Those surveyed did rate highly - in terms of effectiveness - video-tape programs, questioning, group discussions, chalkboard, slide programs, overhead projections, individualized instruction, problem solving, and lecture discussion.

Extension workers must enhance their abilities as professional educators. They must learn how to establish educational objectives, gather and interpret data, design educational objectives, design appropriate learning situations, use a variety of teaching methods, develop lesson plans, and employ evaluation techniques (Astroth & Robbins, 1987).

Extension Program Evaluation

Worthen and Sanders (1987) classified the many different approaches to program evaluation into 6 categories. They are:

1. Objectives-oriented approach, where the focus is on specifying goals and objectives and determining the extent to which they have been attained. The objectives-oriented evaluation approach has dominated the thinking and development of educational evaluation since the 1930s. This summative evaluation approach concentrates on the
measurability of stated objectives and the reliability and validity of these measurements.

2. Management-oriented approach, where the central concern is on identifying and meeting the informational needs of managerial decision-makers. This formative evaluation model has been used by many educational, state, and Federal agencies.

3. Consumer-oriented approach, for use by educational consumers in choosing among competing curricula, instructional products, etc.

4. Expertise-oriented approach, which depends primarily on the direct application of professional expertise to judge the quality of educational programs.

5. Adversary-oriented approach, where planned opposition in points of view of different evaluators is the central focus of the evaluation.

6. Naturalistic and participant-oriented approach, where naturalistic inquiry and involvement of participants are central in determining the values, criteria, needs, and data for the evaluation.

Andrews (1983) stated that the reduced budgeting of the late 1970s and 1980s for educational and social programs has made the Extension system more open to criticism. In this atmosphere the public, legislative bodies, and Extension administration demand justification for program activities. Extension must now focus on results, not just
program efforts, and must objectively evaluate its programs if it is to prosper in this era of accountability and resource constraints.

Program evaluation is the process of judging the worth or value of a program. The two main types of evaluation are process evaluation and impact evaluation. Process evaluation focuses on ways to improve the program. Impact evaluation measures the effectiveness or usefulness of a program. Decision makers focus on impact evaluation studies, and want to know:

1. How has the program affected clientele?
2. What behavioral changes have occurred due to program participation?
3. Was there a reasonable balance between resources used and program accomplishments?
4. How valuable was the program to those who participated (Yearns & Banyas, 1988)?

Patton (1983) viewed evaluation as a specialized application of more general extension principles and methods, because both are involved in:

1. Making research knowledge understandable.
2. Packaging information for decision making purposes.
3. Educating information users.
4. Encouraging people to act on the basis of knowledge.

If the above assumptions are true, evaluation should not be viewed by Extension workers as something alien, threatening, or unknown.

The steps to take in using the parallel process of Extension programming and program evaluation are:
1. Identify the people who are to benefit and be served by the program and/or evaluation.
2. Conduct a needs assessment.
3. Base the information to be disseminated on research.
4. Extend information to the target audience.
5. Conduct a program review.

Summary of Review of the Literature

A review of the literature suggested that Extension professionals concentrate primarily on program content (subject matter) and secondarily on program teaching methodology. Extension professionals should involve clientele to a greater extent in program planning and delivery. Competition from other organizations and individuals for both resources and traditional audience require that Extension programs be prepared for target audiences, that mature programs be re-directed or discarded, and that ongoing program evaluations be conducted. A variety of effective teaching methods and tools are available, and could be used to improve Extension programming.

The review of literature provided the basis for asking the following critical questions:

1. What perceptions do county Extension professionals hold regarding the principles of teaching-learning?
2. What teaching methods are predominantly used and perceived to be effective by county Extension professionals?
3. What instructional tools are predominantly used and perceived to be effective by county Extension professionals?

4. What teaching methods are thought to be potentially effective by county Extension professionals?

5. What instructional tools are thought to be potentially effective by county Extension professionals?

6. What perceptions do county Extension professionals hold regarding the pesticide training program?
CHAPTER III. METHODS AND PROCEDURES OF THE STUDY

Purpose and Objectives

The purpose of this study was to identify and assess the educational delivery systems used by selected county Extension agriculturalists in Iowa, Nebraska, North Dakota, and Wisconsin to train private pesticide applicators.

With respect to pesticide applicator training, the objectives of this study were to:

1. Identify demographic characteristics of county agricultural Extension professionals.
2. Identify perceptions held by county agricultural Extension professionals regarding the principles of teaching-learning.
3. Identify teaching methods and instructional tools used and perceived to be effective by county agricultural Extension professionals in conducting pesticide training programs.
4. Identify perceptions held by county agricultural Extension professionals regarding pesticide training programs.
5. Compare perceptions, use of instructional methods/tools based on selected demographic data.

Chapter III is divided into six major subheadings:

1. Purpose and Objectives
2. Research Design
3. Population and Sample
4. Instrumentation
5. Collection of Data
6. Analysis of Data

Research Design

The descriptive survey method, sometimes called the normative survey method, was used as the data collection approach for this study. This method can be used to process data received by the researcher through observation; whether these data are actually physically observed or "observed" through benefit of questionnaire or poll techniques (Leedy, 1985). A self-administered mail questionnaire was used in data collection for this study because of its practicality in terms of time involvement and expense (Tuckman, 1978).

Population and Sample

The researcher decided to survey county Extension agriculturalists in four of the twelve states within the North Central Region. An assumption was made by the researcher - based on observations made by attending five National Association of County Agricultural Agents (NACAA) annual meetings since 1976 - that county Extension agricultural professionals in the United States form a mostly homogeneous group (male with a farm background). Historically, a large portion of Extension professionals have had farm backgrounds (Bachtel, 1989). To reduce the
chance of a type two error occurring (failure to reject a false null hypothesis), the researcher decided to survey one-half of the county Extension agriculturalists in the four states selected for this study (153 county agricultural Extension professionals out of 306). Addresses were obtained from the 1989-90 County Agents Directory (Miller et al., 1988). A stratified-by-county sampling plan (selection of every other name and address of county Extension agriculturalists) was used to determine who would receive the questionnaire.

States selected for this study were Iowa, Nebraska, North Dakota, and Wisconsin. Iowa was automatically selected to be included in this study because: (1) the researcher was employed by the Iowa Cooperative Extension Service and was familiar with its mission and, (2) Iowa Cooperative Extension Service Administration requested that Iowa be included in this study. The other eleven states were randomly ranked, from one to eleven, by drawing state names from a box. The first three states drawn (Nebraska, North Dakota, and Wisconsin) were included in this study. Permission to conduct this study was received from state Extension administrators in Iowa, Nebraska, North Dakota, and Wisconsin (Appendix, pages 117 - 120).

Instrumentation

A survey questionnaire was designed to collect data for this study (Appendix, page 122). The sources of information used in developing this instrument were; (1) the literature discussed in Chapter II, (2) the
instrument used in a study by Martin and Omer (1986) on instructional methods used in adult education and extension programs in agriculture, (3) the instrument used by Odubiyi (1988) on instructional methods used by vocational agricultural instructors in Iowa, (4) input from the researcher's dissertation committee and other faculty members within the Department of Agricultural Education and Studies, and (5) the researcher's personal experience.

To improve the survey instrument and verify it for content validity, the questionnaire was pre-tested by ten Iowa county Extension agriculturalists. These individuals had not previously been selected to receive the instrument, so their input was not included in statistical evaluations. Upon their suggestions, questions were modified or deleted, and wording improved. It took an average of ten minutes for these ten individuals to complete the questionnaire.

The survey instrument covered the following areas:

1. Appraisal by the respondents regarding perceptions held regarding principles of teaching-learning in pesticide training.

2. Appraisal by the respondents regarding teaching methods and instructional tools currently used and perceived to be effective in pesticide training.

3. Appraisal by the respondents regarding the potential of teaching methods and instructional tools in pesticide training.
4. Appraisal by the respondents regarding perceptions held regarding the pesticide training program.

5. Demographic characteristics of the respondents.

Likert-type scales were used for areas 1 and 4 as follows:

1 = Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, and 5 = Strongly Agree.

For area 2, the following Likert-type scale was used:

1 = Not Used, 2 = Rarely Used, 3 = Sometimes Used, 4 = Frequently Used, and 5 = Heavily Used.

For area 3, the following Likert-type scale was used:

1 = Not Effective, 2 = Of Little Effectiveness, 3 = Somewhat Effective, 4 = Effective, and 5 = Very Effective.

Iowa State University’s Committee on Use of Human Subjects reviewed and approved the questionnaire. This review insured that personal rights were not violated by using this data collection instrument (Appendix, page 135).

Collection of Data

Questionnaires were mailed and received during September, 1989. Questionnaires were identified alphabetically and numerically (example: IA-01 for the first county Extension agriculturalist in Iowa to be listed in the 1989-90 County Agents Directory, IA-02 for the third one to be listed, etc.) to identify non-respondents for follow-up efforts to collect completed questionnaires. After receiving a returned questionnaire, the
Identification was removed. Dillman's (1978) Total Design Method (TDM) was employed in instrument preparation to achieve a better response and return from recipients. Eighty-five percent of the surveys (130 out of 153) were returned after county Extension agriculturalists received the first mailing (Appendix, page 121) and/or the reminder postcard (Appendix, page 133) that was mailed two weeks after the first mailing. A ninety-eight percent return was achieved (150 out of 153) following the second mailing of the questionnaire with a follow-up letter in September, 1989 to non-respondents (Appendix, page 134).

One hundred and fifty out of one hundred fifty-three questionnaires were returned. One of the questionnaires arrived too late to be included in the study. Eight county Extension agriculturalists returned blank questionnaires. The number of non-respondents (3) was too small to survey by telephone, in order to see if their response to survey questions would be statistically different from respondents.

Analysis of Data

Data were statistically analyzed by using SPSS/PC+, The Statistical Package for the IBM Personal Computer. The .05 level of significance was set a priori as the critical value for all analysis, using the Scheffé method (Hinkle et al., 1988). Means, standard deviations, correlations, t-tests, and analysis of variance were used in this study. The data were analyzed to address each objective of the study.
CHAPTER IV. PRESENTATION AND ANALYSIS OF DATA

Purpose and Objectives

The purpose of this study was to identify and assess the educational delivery systems used by county Extension agriculturalists in Iowa, Nebraska, North Dakota, and Wisconsin to train private pesticide applicators.

With respect to pesticide applicator training, the objectives of this study were to:

1. Identify demographic characteristics of county agricultural Extension professionals.
2. Identify perceptions held by county agricultural Extension professionals regarding principles of teaching-learning.
3. Identify teaching methods and instructional tools used and perceived to be effective by county agricultural Extension professionals in conducting pesticide training programs.
4. Identify perceptions held by county agricultural Extension professionals regarding pesticide training programs.
5. Compare perceptions, use of instructional methods/tools based on selected demographic data.

Chapter IV presents the results obtained from the statistical analysis of the data. The chapter is divided into seven major subheadings:

1. Purpose and Objectives
2. Reliability Tests
3. Demographic Information
4. Perceptions Held Regarding Principles of Teaching-Learning
5. Teaching Methods and Instructional Tools Used and Perceived to be Effective
6. Perceptions Held Regarding Pesticide Training Programs
7. Comparison of Perceptions and Use of Instructional Methods/Tools Based on Selected Demographic Data
8. Selected Comments from the Respondents

Reliability Tests

The survey instrument's internal consistency and stability of grouped items was determined using the Cronbach's alpha statistical procedure (SPSS Inc., 1988). Results of the reliability tests are presented in Table 1. The alpha coefficient for the entire instrument on perceptions held regarding principles of teaching-learning, teaching methods and instructional tools used and perceived to be effective, and perceptions held regarding the pesticide training program was .91. The alpha coefficient for the subgroups within the survey instrument ranged from .74 to .88. The coefficient values were considered high enough to proceed with statistical analysis and interpretation.
Table 1. Results of reliability tests on the survey instrument regarding teaching-learning principles, teaching methods and instructional tools used, potential effectiveness of teaching methods and instructional tools, and perceptions regarding the pesticide training program

<table>
<thead>
<tr>
<th>Instrument scale</th>
<th>Number of items in scale</th>
<th>Cronbach's alpha coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching-learning principles</td>
<td>17</td>
<td>.85</td>
</tr>
<tr>
<td>Teaching methods and instructional tools used</td>
<td>32</td>
<td>.88</td>
</tr>
<tr>
<td>Potential effectiveness of teaching methods and</td>
<td>32</td>
<td>.88</td>
</tr>
<tr>
<td>instructional tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceptions regarding the pesticide training program</td>
<td>10</td>
<td>.74</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>.91</td>
</tr>
</tbody>
</table>

Demographic Information

Eleven (7.4%) of the 149 county Extension agriculturalists who returned the questionnaire and were included in this study did not indicate their gender. Of those answering this question (138), 4 (3.0%) were female, and 134 (97.0%) were male. These data are summarized in Table 2. The disproportionate ratio of male and female county Extension agriculturalists did not allow a statistical analysis of responses to questions based on gender of respondents.
Table 2. Number of county Extension professionals based on gender

<table>
<thead>
<tr>
<th></th>
<th>Iowa</th>
<th>N. Dakota</th>
<th>Nebraska</th>
<th>Wisconsin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>48</td>
<td>24</td>
<td>33</td>
<td>29</td>
<td>134</td>
</tr>
<tr>
<td>Female</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>28</td>
<td>38</td>
<td>34</td>
<td>149</td>
</tr>
</tbody>
</table>

Ten (6.7%) of the 149 county Extension agriculturalists who returned the questionnaire and were included in this study did not list their age. Nine respondents (6.5%) were in the 20 - 29 year old age range, 38 (27.3%) were in the 30 to 39 year old age range, 45 (32.4%) were in the 40 - 50 year old age range, 35 (25.2%) were in the 50 - 59 year old age range, and 12 (8.6%) were 60 years of age or older. Iowa had the highest percentage of county Extension agriculturalists 60 plus years of age (16.7%), and Wisconsin had the lowest percentage (3.3%). The average age of all respondents was 44. The average age of respondents in each state was: Iowa - 45, North Dakota - 41, Nebraska - 44, and Wisconsin - 43. These data are summarized in Table 3.

Table 3. Number of county Extension professionals according to age

<table>
<thead>
<tr>
<th>Age range</th>
<th>Iowa</th>
<th>N. Dakota</th>
<th>Nebraska</th>
<th>Wisconsin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 or less</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20 - 29 yrs</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>30 - 39 yrs</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>5</td>
<td>38</td>
</tr>
<tr>
<td>40 - 49 yrs</td>
<td>11</td>
<td>8</td>
<td>12</td>
<td>14</td>
<td>45</td>
</tr>
<tr>
<td>50 - 59 yrs</td>
<td>13</td>
<td>4</td>
<td>11</td>
<td>7</td>
<td>35</td>
</tr>
</tbody>
</table>
Table 3. continued

<table>
<thead>
<tr>
<th>Age range</th>
<th>Iowa</th>
<th>N. Dakota</th>
<th>Nebraska</th>
<th>Wisconsin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 + years</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>28</td>
<td>38</td>
<td>34</td>
<td>149</td>
</tr>
</tbody>
</table>

Twelve (8.1%) of the 149 county Extension agriculturalists returning the questionnaire and included in this study did not indicate whether or not they had any years of formal teaching experience. The average number of years of formal teaching experience of all respondents was 9. The average number of years of formal teaching experience of respondents in each state was: Iowa - 8, North Dakota - 6, Nebraska - 7, and Wisconsin - 14. This question may have been mis-interpreted, causing a few respondents to include their teaching experience in the Extension system under years of formal teaching experience. These data are summarized in Table 4.

Table 4. Number of county Extension professionals according to years of formal teaching experience (vocational, college, community college, etc.)

<table>
<thead>
<tr>
<th>No. years</th>
<th>Iowa</th>
<th>N. Dakota</th>
<th>Nebraska</th>
<th>Wisconsin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>13</td>
<td>11</td>
<td>11</td>
<td>1</td>
<td>36</td>
</tr>
<tr>
<td>1 - 5</td>
<td>10</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>6 - 10</td>
<td>10</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>26</td>
</tr>
<tr>
<td>11 - 15</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>16 - 20</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>15</td>
</tr>
</tbody>
</table>
Table 4. continued

<table>
<thead>
<tr>
<th>No. years</th>
<th>Iowa</th>
<th>N. Dakota</th>
<th>Nebraska</th>
<th>Wisconsin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 - 25</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>26 +</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>28</td>
<td>38</td>
<td>34</td>
<td>149</td>
</tr>
</tbody>
</table>

Ten of 149 county Extension professionals (6.7%) did not list their years as an employee of the Extension system. Of those answering this question (139), 8 (5.8%) listed less than one year of service, 27 (19.4%) indicated 1 - 5 years, 25 (18.0%) listed 6 - 10 years, 21 (15.1%) indicated 11 - 15 years, 11 (7.9%) listed 16 - 20 years, 18 (12.9%) indicated 21 - 25 years, and 29 (20.9%) listed 26 years or more of Extension system employment. Eighty-one respondents out of 139 (58.3%) indicated from less than 1 to 15 years of employment with the Extension system. The average years of service as an employee of the Extension system of all respondents was 14. The average years of service as an employee of the Extension system of respondents in each state was: Iowa - 14, North Dakota - 15, Nebraska - 15, and Wisconsin - 11. These data are summarized in Table 5.

Table 5. Number of county Extension professionals according to years of service as an employee of the Extension system

<table>
<thead>
<tr>
<th>No. Years</th>
<th>Iowa</th>
<th>N. Dakota</th>
<th>Nebraska</th>
<th>Wisconsin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>1 - 5</td>
<td>12</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>27</td>
</tr>
<tr>
<td>6 - 10</td>
<td>7</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>11 - 15</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>16 - 20</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>11</td>
</tr>
</tbody>
</table>
Eleven county Extension professionals out of 149 (7.4%) did not indicate their highest educational level attained. Of those answering this question, forty (29.0%) indicated a bachelor's degree, 95 (68.8%) listed a master's degree and 3 (2.2%) indicated a doctorate. North Dakota had the highest percentage of county Extension agriculturalists with only a bachelor's degree (72.0%), and Wisconsin had the lowest percentage (6.7%). These data are summarized in Table 6.

Table 5. continued

<table>
<thead>
<tr>
<th>No. Years</th>
<th>Iowa</th>
<th>N. Dakota</th>
<th>Nebraska</th>
<th>Wisconsin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 - 25</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>26 +</td>
<td>13</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>29</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>28</td>
<td>38</td>
<td>34</td>
<td>149</td>
</tr>
</tbody>
</table>

Table 6. Number of county Extension professionals according to highest educational level attained

<table>
<thead>
<tr>
<th>Education</th>
<th>Iowa</th>
<th>N. Dakota</th>
<th>Nebraska</th>
<th>Wisconsin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor's</td>
<td>17</td>
<td>18</td>
<td>3</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Master's</td>
<td>30</td>
<td>7</td>
<td>32</td>
<td>26</td>
<td>95</td>
</tr>
<tr>
<td>Doctorate</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>28</td>
<td>38</td>
<td>34</td>
<td>149</td>
</tr>
</tbody>
</table>
Perceptions Held Regarding Principles of Teaching-Learning

In Table 7, county Extension agriculturalists surveyed show agreement to strong agreement (mean range from 4.04 to 4.65) on 10 teaching-learning principles. Standard deviations were less than .76 (range from .49 to .75). The items are listed here according to mean scores:

1. Prepare a comfortable and non-threatening teaching-learning environment.
2. Use a variety of instructional methods.
3. Recognize that individual differences exist among learners.
4. Possess the relevant and required teaching ability and skills.
5. Clarify the program objectives to learners.
6. Identify and use educational principles and procedures in teaching.
7. Use decision making situations in teaching.
8. Develop and use a definite and specific interest approach to enhance the learner's motivation.
9. Evaluate the product of the teaching-learning situation (i.e., subject matter learned).
10. Evaluate the teaching-learning process.

The remaining 7 teaching-learning principles (Table 7) had mean scores ranging from 3.36 (uncertain) to 3.99 (agree). Standard deviations ranged from .85 to 1.03. This information indicated there was less
agreement between county Extension professionals regarding these items. The items are listed here according to their mean scores:

11. Be knowledgeable in each subject matter area taught.
12. Prepare instructional plans designed to enhance the teaching-learning process.
13. Use a variety of evaluation procedures.
14. Use group instruction in dealing with specific problems.
15. Prepare and use self-directed teaching-learning aids.
16. Use individualized instruction to help learners solve problems.
17. Involve learners in the program planning process.

Table 7. Means and standard deviations of perceptions held by selected county Extension agriculturalists regarding principles of teaching-learning

<table>
<thead>
<tr>
<th>In teaching proper pesticide use, etc., county Extension agriculturalists should:</th>
<th>Valid cases</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use individualized instruction to help learners solve problems.</td>
<td>135</td>
<td>3.37</td>
<td>1.03</td>
</tr>
<tr>
<td>Identify and use educational principles and procedures in teaching.</td>
<td>136</td>
<td>4.29</td>
<td>.63</td>
</tr>
<tr>
<td>Use a variety of instructional methods.</td>
<td>137</td>
<td>4.53</td>
<td>.61</td>
</tr>
<tr>
<td>Use decision making situations in teaching.</td>
<td>136</td>
<td>4.21</td>
<td>.69</td>
</tr>
<tr>
<td>Develop and use a definite and specific interest approach to enhance the learner's motivation.</td>
<td>137</td>
<td>4.15</td>
<td>.75</td>
</tr>
<tr>
<td>Prepare instructional plans designed to enhance the teaching-learning process.</td>
<td>136</td>
<td>3.90</td>
<td>.86</td>
</tr>
<tr>
<td>Clarify the program objectives to learners.</td>
<td>137</td>
<td>4.33</td>
<td>.65</td>
</tr>
</tbody>
</table>
Table 7. continued

<table>
<thead>
<tr>
<th>In teaching proper pesticide use, etc., county Extension agriculturalists should:</th>
<th>Valid cases</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate the teaching-learning process.</td>
<td>137</td>
<td>4.04</td>
<td>.73</td>
</tr>
<tr>
<td>Use group instruction in dealing with specific problems.</td>
<td>137</td>
<td>3.65</td>
<td>.98</td>
</tr>
<tr>
<td>Evaluate the product of the teaching-learning situation (i.e., subject matter learned).</td>
<td>136</td>
<td>4.05</td>
<td>.72</td>
</tr>
<tr>
<td>Be knowledgeable in each subject matter area taught.</td>
<td>137</td>
<td>3.99</td>
<td>.96</td>
</tr>
<tr>
<td>Prepare a comfortable and non-threatening teaching-learning environment.</td>
<td>136</td>
<td>4.65</td>
<td>.49</td>
</tr>
<tr>
<td>Possess the relevant and required teaching ability and skills.</td>
<td>137</td>
<td>4.39</td>
<td>.61</td>
</tr>
<tr>
<td>Recognize that individual differences exist among learners</td>
<td>136</td>
<td>4.51</td>
<td>.57</td>
</tr>
<tr>
<td>Involve learners in the program planning process.</td>
<td>137</td>
<td>3.36</td>
<td>.92</td>
</tr>
<tr>
<td>Prepare and use self-directed teaching-learning aids.</td>
<td>135</td>
<td>3.42</td>
<td>.85</td>
</tr>
<tr>
<td>Use a variety of evaluation procedures.</td>
<td>119</td>
<td>3.75</td>
<td>.89</td>
</tr>
</tbody>
</table>

Scale: 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree

Table 8 shows that participants in all 4 states gave the following teaching-learning principle the highest rating: "Prepare a comfortable and non-threatening teaching-learning environment." Three of 4 states listed "use a variety of instructional methods" as the second highest rated principle. The following principles were highly rated by participants in all 4 states (rank order according to mean score):
1. Prepare a comfortable and non-threatening teaching-learning environment.

2. Use a variety of instructional methods.

3. Recognize that individual differences exist among learners.

4. Possess the relevant and required teaching ability and skills.

5. Clarify the program objectives to learners.

6. Identify and use educational principles and procedures in teaching.

7. Use decision making situations in teaching.

8. Develop and use a definite and specific interest approach to enhance the learner’s motivation.

The following three principles were consistently rated low in mean score by county Extension agriculturalists in all 4 states:

1. Prepare and use self-directed teaching-learning aids.

2. Use individualized instruction to help learners solve problems.

3. Involve learners in the program planning process.
Table 8. Means and standard deviations of perceptions held by county Extension agriculturalists in Iowa, Nebraska, North Dakota and Wisconsin regarding principles of teaching-learning

<table>
<thead>
<tr>
<th>In teaching proper pesticide use, etc., county Extension agriculturalists should:</th>
<th>Iowa</th>
<th>Nebraska</th>
<th>North Dakota</th>
<th>Wisconsin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
<td>S.D.</td>
<td>n</td>
</tr>
<tr>
<td>Use individualized instruction to help learners solve problems.</td>
<td>48</td>
<td>3.98</td>
<td>1.00</td>
<td>32</td>
</tr>
<tr>
<td>Identify and use educational principles and procedures in teaching.</td>
<td>48</td>
<td>4.40</td>
<td>.54</td>
<td>33</td>
</tr>
<tr>
<td>Use a variety of instructional methods.</td>
<td>48</td>
<td>4.65</td>
<td>.53</td>
<td>34</td>
</tr>
<tr>
<td>Use decision making situations in teaching.</td>
<td>47</td>
<td>4.28</td>
<td>.74</td>
<td>34</td>
</tr>
<tr>
<td>Develop and use a definite and specific interest approach to enhance the learner's motivation.</td>
<td>48</td>
<td>4.27</td>
<td>.64</td>
<td>34</td>
</tr>
<tr>
<td>Prepare instructional plans designed to enhance the teaching-learning process.</td>
<td>47</td>
<td>3.92</td>
<td>.95</td>
<td>34</td>
</tr>
<tr>
<td>Clarify the program objectives to learners.</td>
<td>48</td>
<td>4.21</td>
<td>.82</td>
<td>34</td>
</tr>
</tbody>
</table>
Table 8. continued

In teaching proper pesticide use, etc., county Extension agriculturalists should:

<table>
<thead>
<tr>
<th>In teaching proper pesticide use, etc., county Extension agriculturalists should:</th>
<th>Iowa</th>
<th>Nebraska</th>
<th>North Dakota</th>
<th>Wisconsin</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Mean</td>
<td>S.D.</td>
<td>n</td>
<td>Mean</td>
</tr>
<tr>
<td>Evaluate the teaching-learning process.</td>
<td>48</td>
<td>4.17</td>
<td>.66</td>
<td>34</td>
</tr>
<tr>
<td>Use group instruction in dealing with specific problems.</td>
<td>48</td>
<td>3.71</td>
<td>.87</td>
<td>34</td>
</tr>
<tr>
<td>Evaluate the product of the teaching-learning situation.</td>
<td>47</td>
<td>4.17</td>
<td>.70</td>
<td>34</td>
</tr>
<tr>
<td>Be knowledgeable in each subject matter area taught.</td>
<td>48</td>
<td>4.17</td>
<td>.81</td>
<td>34</td>
</tr>
<tr>
<td>Recognize that individual differences exist among learners.</td>
<td>47</td>
<td>4.57</td>
<td>.54</td>
<td>34</td>
</tr>
<tr>
<td>Prepare a comfortable and non-threatening teaching-learning environment.</td>
<td>47</td>
<td>4.66</td>
<td>.52</td>
<td>34</td>
</tr>
<tr>
<td>Possess the relevant and required teaching ability and skills.</td>
<td>48</td>
<td>4.42</td>
<td>.61</td>
<td>34</td>
</tr>
<tr>
<td>Involve learners in the program planning process.</td>
<td>48</td>
<td>3.50</td>
<td>.99</td>
<td>34</td>
</tr>
<tr>
<td>Prepare and use self-directed teaching-learning aids.</td>
<td>47</td>
<td>3.51</td>
<td>.83</td>
<td>34</td>
</tr>
</tbody>
</table>
Table 8. continued

<table>
<thead>
<tr>
<th></th>
<th>Iowa</th>
<th>Nebraska</th>
<th>North Dakota</th>
<th>Wisconsin</th>
<th>Dakota</th>
</tr>
</thead>
<tbody>
<tr>
<td>In teaching proper pesticide use, etc., county Extension agriculturalists should:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use a variety of evaluation procedures.</td>
<td>n Mean S.D.</td>
<td>n Mean S.D.</td>
<td>n Mean S.D.</td>
<td>n Mean S.D.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>3.91</td>
<td>.84</td>
<td>30</td>
<td>3.40</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>3.89</td>
<td>.90</td>
<td>28</td>
<td>3.79</td>
</tr>
</tbody>
</table>

Scale: 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree

Table 9 shows that the ratings for two principles of teaching-learning were significantly different (at the .05 confidence level) between states. County Extension agriculturalists in North Dakota rated "Evaluate the teaching-learning process" lower (3.67) than Nebraska (3.94), and significantly lower than either Iowa (4.17) or Wisconsin (4.26). County Extension agriculturalists in Wisconsin rated "Evaluating the product of the teaching-learning situation (i.e., subject matter learned)" higher (4.36) than Iowa (4.17) and significantly higher than either Nebraska (3.82) or North Dakota (3.75). The means of all other items were not found to be significantly different statistically based on perceptions held regarding principles of teaching-learning.
Table 9. Analysis of variance between states of perceptions held regarding principles of teaching-learning

<table>
<thead>
<tr>
<th></th>
<th>MS between</th>
<th>MS within</th>
<th>F ratio</th>
<th>F prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>In teaching proper pesticide use, environmental concerns, etc., county Extension agriculturalists should:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate the teaching-learning process&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.973</td>
<td>.495</td>
<td>3.99</td>
<td>.009*</td>
</tr>
<tr>
<td>Evaluate the product of the teaching-learning situation&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.488</td>
<td>.479</td>
<td>5.20</td>
<td>.002*</td>
</tr>
</tbody>
</table>

<sup>a</sup>North Dakota significantly different from Iowa and Wisconsin.
<sup>b</sup>Wisconsin significantly different from North Dakota and Nebraska.
*Significant at .05 level.

Teaching Methods and Instructional Tools Used and Perceived to be Effective

Table 10 shows that in this study county Extension agriculturalists designated 35 mm slides to be the most frequently used teaching tool (rated number 2 for perceived effectiveness), followed by the overhead projector (rated number 9 for perceived effectiveness). The highest rated methods by mean score were: lecture-discussion (number 3), questioning (number 4), and lecture (number 5). Perceived effectiveness for these 3 methods were rated lower than perceived actual use. The N = 92 in the Table 10 heading indicates the number of participants that answered all questions in Part II of the questionnaire.
Hinkle et al. (1988) lists the following rule of thumb for interpreting the size of a correlation coefficient:

<table>
<thead>
<tr>
<th>Size of Correlation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.90 to 1.00 (-.90 to -1.00)</td>
<td>Very high positive (negative) correlation</td>
</tr>
<tr>
<td>.70 to .90 (-.70 to -.90)</td>
<td>High positive (negative) correlation</td>
</tr>
<tr>
<td>.50 to .70 (-.50 to -.70)</td>
<td>Moderate positive (negative) correlation</td>
</tr>
<tr>
<td>.30 to .50 (-.30 to -.50)</td>
<td>Low positive (negative) correlation</td>
</tr>
<tr>
<td>.00 to .30 (.00 to -.30)</td>
<td>Little if any correlation</td>
</tr>
</tbody>
</table>

A low to moderate positive correlation was found between extent of use and perceived effectiveness for 25 teaching methods and instructional tools. Seven teaching methods and instructional tools received higher mean scores in perceived effectiveness than they did in extent of use. They were: (1) individual instruction, (2) video tape programs, (3) tours, (4) motion pictures, (5) television, (6) satellite, and (7) the flannel board. As a result, there was little if any correlation between extent of use and perceived effectiveness for these 7 teaching methods and instructional tools. Teaching methods and instructional tools rarely used by county Extension agriculturalists included buzz groups, role playing, and the flannel board.
Table 10. Means, standard deviations, and correlations of teaching methods and instructional tools used and perceived to be effective by selected county Extension agriculturalists (N = 92)

<table>
<thead>
<tr>
<th>Teaching methods and instructional tools</th>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extent of use</td>
<td>Perceived effectiveness</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>35 mm slides</td>
<td>4.52</td>
<td>.80</td>
</tr>
<tr>
<td>Overhead projector</td>
<td>3.67</td>
<td>1.06</td>
</tr>
<tr>
<td>Lecture - discussion</td>
<td>3.55</td>
<td>.87</td>
</tr>
<tr>
<td>Questioning</td>
<td>3.43</td>
<td>.82</td>
</tr>
<tr>
<td>Lecture</td>
<td>3.39</td>
<td>1.02</td>
</tr>
<tr>
<td>News stories</td>
<td>3.29</td>
<td>.93</td>
</tr>
<tr>
<td>Problem solving</td>
<td>3.28</td>
<td>1.03</td>
</tr>
<tr>
<td>Self study</td>
<td>3.21</td>
<td>1.06</td>
</tr>
<tr>
<td>Tape recorder</td>
<td>3.14</td>
<td>1.50</td>
</tr>
<tr>
<td>Group discussion</td>
<td>3.03</td>
<td>.91</td>
</tr>
<tr>
<td>Individual instruction</td>
<td>2.93</td>
<td>1.05</td>
</tr>
<tr>
<td>Workshops</td>
<td>2.93</td>
<td>1.40</td>
</tr>
<tr>
<td>Demonstration</td>
<td>2.91</td>
<td>.98</td>
</tr>
<tr>
<td>Newsletters</td>
<td>2.84</td>
<td>1.23</td>
</tr>
<tr>
<td>Video tape programs</td>
<td>2.50</td>
<td>1.19</td>
</tr>
<tr>
<td>Case study</td>
<td>2.48</td>
<td>1.20</td>
</tr>
<tr>
<td>Radio</td>
<td>2.41</td>
<td>1.27</td>
</tr>
<tr>
<td>Exhibits</td>
<td>2.27</td>
<td>1.01</td>
</tr>
<tr>
<td>Pest specimens</td>
<td>2.20</td>
<td>1.14</td>
</tr>
<tr>
<td>Tours</td>
<td>2.11</td>
<td>1.11</td>
</tr>
<tr>
<td>Instructional posters</td>
<td>2.10</td>
<td>1.02</td>
</tr>
<tr>
<td>Chalkboard</td>
<td>2.09</td>
<td>1.03</td>
</tr>
</tbody>
</table>

*Low positive correlation.

**Moderate positive correlation.
Table 10. continued

<table>
<thead>
<tr>
<th>Teaching methods and instructional tools</th>
<th>Column A</th>
<th></th>
<th>Column B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extent of use</td>
<td>Perceived effectiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>Flip chart</td>
<td>1.95</td>
<td>1.03</td>
<td>2.99</td>
<td>.92</td>
</tr>
<tr>
<td>Motion pictures</td>
<td>1.79</td>
<td>1.04</td>
<td>3.29</td>
<td>.99</td>
</tr>
<tr>
<td>Panel discussion</td>
<td>1.73</td>
<td>.94</td>
<td>3.08</td>
<td>1.03</td>
</tr>
<tr>
<td>Television</td>
<td>1.73</td>
<td>1.02</td>
<td>3.03</td>
<td>.93</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>1.62</td>
<td>1.06</td>
<td>2.62</td>
<td>1.17</td>
</tr>
<tr>
<td>Computer-aided instruction</td>
<td>1.53</td>
<td>.84</td>
<td>2.99</td>
<td>.97</td>
</tr>
<tr>
<td>Satellite</td>
<td>1.53</td>
<td>.98</td>
<td>3.05</td>
<td>1.03</td>
</tr>
<tr>
<td>Buzz groups</td>
<td>1.46</td>
<td>.89</td>
<td>2.48</td>
<td>1.12</td>
</tr>
<tr>
<td>Role playing</td>
<td>1.34</td>
<td>.75</td>
<td>2.35</td>
<td>1.08</td>
</tr>
<tr>
<td>Flannel board</td>
<td>1.30</td>
<td>.62</td>
<td>2.54</td>
<td>1.04</td>
</tr>
</tbody>
</table>

Column A scale: 1 = not used, 2 = rarely used, 3 = sometimes used, 4 = frequently used, 5 = heavily used
Column B scale: 1 = not effective, 2 = of little effectiveness, 3 = somewhat effective, 4 = effective, 5 = very effective

Table 11 shows that there were many significant statistical differences between states regarding the extent of use of teaching methods and instructional tools. With respect to the extent of use: (1) Iowa county Extension agriculturalists did not use the teaching method group discussion as much as agriculturalists did in the other 3 states, and there was a highly significant statistical difference between Iowa (mean, 2.59) and Wisconsin county Extension agriculturalists (mean, 3.43) in this area. (2) Wisconsin county Extension agriculturalists occasionally used questioning as a teaching method, when compared to usage by
agriculturalists in the other 3 states. Their response was significantly different statistically (mean, 2.86) from that of Nebraska (mean, 3.53) and North Dakota county Extension agriculturalists (mean, 3.58). (3) Iowa county Extension agriculturalists rarely used the tape recorder as a teaching tool, when compared to usage by agriculturalists in the other 3 states. This difference (mean, 2.40) was significant statistically from North Dakota county Extension agriculturalists (mean, 3.46) and highly significant statistically from agriculturalists in Wisconsin (mean, 3.64) and Nebraska (mean, 4.17). (4) Iowa county Extension agriculturalists rarely used video tape programs as an instructional method, when compared to agriculturalists in the other 3 states, and there was a highly significant statistical difference between Iowa (mean, 1.98) and North Dakota county Extension agriculturalists (mean, 3.21) in this area. (5) Iowa county Extension agriculturalists rarely used the satellite as a teaching tool. But their response was higher than agriculturalists from the other 3 states, and there was a significant statistical difference between North Dakota (mean, 1.09) and Iowa county Extension agriculturalists (mean, 1.76) in this area. (6) Iowa county Extension agriculturalists used the overhead projector as a teaching tool more frequently than agriculturalists in the other 3 states, and there was a significant statistical difference between Nebraska (mean, 3.06) and Iowa county Extension agriculturalists (mean, 3.86). (7) Iowa county Extension agriculturalists indicated that they used 35 mm slides as a teaching tool more extensively than agriculturalists did in the other 3 states, and there was a significant statistical difference between
Wisconsin (mean, 4.10) and Iowa county Extension agriculturalists (mean, 4.73). (8) North Dakota county Extension agriculturalists used pest specimens as a teaching tool more than agriculturalists did in the other 3 states, and there was a significant statistical difference between Iowa (mean, 1.86) and North Dakota county Extension agriculturalists (mean, 2.71). (9) North Dakota used news stories as an instructional method more frequently than agriculturalists in the other 3 states, and there was a significant statistical difference between Iowa (mean, 2.93) and North Dakota county Extension agriculturalists (mean, 3.72). (10) North Dakota county Extension agriculturalists used workshops as an instructional method more often than agriculturalists in the other 3 states, and there was a highly significant statistical difference between Iowa (mean, 2.21) and North Dakota county Extension agriculturalists (mean, 3.46) in this area. (11) Iowa county Extension agriculturalists used self study as an instructional method more frequently than agriculturalists in the other 3 states, and there was a highly significant statistical difference between Wisconsin (mean, 2.71) and Iowa county Extension agriculturalists (mean, 3.66) in this area.

There were no other significant differences regarding teaching methods and instructional tools used by selected county Extension agriculturalists.
Table 11. Analysis of variance between states regarding teaching methods and instructional tools used by selected county Extension agriculturalists

<table>
<thead>
<tr>
<th>Extent of use</th>
<th>MS between</th>
<th>MS within</th>
<th>F ratio</th>
<th>F prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group discussiona</td>
<td>4.078</td>
<td>.902</td>
<td>4.52</td>
<td>.005*</td>
</tr>
<tr>
<td>Questioningb</td>
<td>3.135</td>
<td>.781</td>
<td>4.02</td>
<td>.009*</td>
</tr>
<tr>
<td>Tape recorderc</td>
<td>22.419</td>
<td>1.815</td>
<td>12.35</td>
<td>.000*</td>
</tr>
<tr>
<td>Videotape programd</td>
<td>7.942</td>
<td>1.449</td>
<td>5.48</td>
<td>.001*</td>
</tr>
<tr>
<td>Satellitee</td>
<td>2.986</td>
<td>.727</td>
<td>4.11</td>
<td>.008*</td>
</tr>
<tr>
<td>Overhead projectorf</td>
<td>5.161</td>
<td>1.261</td>
<td>4.09</td>
<td>.008*</td>
</tr>
<tr>
<td>35 mm slidesg</td>
<td>3.073</td>
<td>.783</td>
<td>3.93</td>
<td>.010*</td>
</tr>
<tr>
<td>Pest specimensh</td>
<td>3.985</td>
<td>1.163</td>
<td>3.43</td>
<td>.019*</td>
</tr>
<tr>
<td>News storiesi</td>
<td>3.600</td>
<td>1.128</td>
<td>3.19</td>
<td>.026*</td>
</tr>
<tr>
<td>Workshopsj</td>
<td>8.682</td>
<td>1.988</td>
<td>4.37</td>
<td>.006*</td>
</tr>
<tr>
<td>Self studyk</td>
<td>5.503</td>
<td>.991</td>
<td>5.56</td>
<td>.001*</td>
</tr>
</tbody>
</table>

a Iowa significant at .05 level from Wisconsin.
b Wisconsin significant at .05 level from Nebraska and North Dakota.
c Iowa significant at .05 level from North Dakota, Wisconsin and Nebraska.
d Iowa significant at .05 level from North Dakota.
e North Dakota significant at .05 level from Iowa.
f Nebraska significant at .05 level from Iowa.
g Wisconsin significant at .05 level from Iowa.
h Iowa significant at .05 level from North Dakota.
i Iowa significant at .05 level from North Dakota.
j Iowa significant at .05 level from North Dakota.
k Wisconsin significant at .05 level from Iowa.

*Significant at .05 level.

Table 12 shows that there were many significant statistical differences between states regarding perceived effectiveness of teaching methods and instructional tools. With respect to perceived effectiveness:

(1) North Dakota and Iowa respondents believed more strongly than
respondents in the other 2 states that questioning could be an effective instructional method, and there was a significant statistical difference between Wisconsin (mean, 3.25) and Iowa (mean, 3.79) and North Dakota respondents (mean, 3.96) in this area.  (2) Iowa and Wisconsin respondents believed more strongly than respondents in the other 2 states that problem solving could be an effective instructional method, and there was a significant statistical difference between Nebraska (mean, 3.33) and Wisconsin respondents (mean, 4.00), and a highly significant statistical difference between Nebraska and Iowa respondents (mean, 4.02) in this area.  (3) Nebraska county Extension agriculturalists believed more strongly than agriculturalists in the other 3 states that the tape recorder could be an effective teaching tool, and there was a significant statistical difference between Nebraska (mean, 3.53) and Iowa county Extension agriculturalists (mean, 2.88) in this area.  (4) Iowa county Extension agriculturalists felt more strongly than agriculturalists in the other 3 states that pest specimens could be an effective teaching tool, and there was a significant statistical difference between Iowa (mean, 4.05) and Wisconsin county Extension agriculturalists (mean, 3.30) in this area.  (5) North Dakota (mean, 3.90) and Nebraska county Extension agriculturalists (mean, 3.84) believed more strongly than agriculturalists in the other 2 states that workshops could be an effective instructional method, and there was a significant statistical difference between county Extension agriculturalists in these 2 states and Wisconsin county Extension agriculturalists (mean, 3.12) in this area.  (6) North Dakota county Extension agriculturalists felt more strongly than
agriculturalists in the other 3 states that exhibits could be an effective instructional method, and there was a significant statistical difference between North Dakota (mean, 3.55) and Wisconsin county Extension agriculturalists (mean, 2.64) in this matter. Iowa county Extension agriculturalists believed more strongly than agriculturalists in the other 3 states that self study could be an effective instructional method. There was a significant statistical difference between Iowa (mean, 3.93) and Wisconsin county Extension agriculturalists (mean, 3.29), and a highly significant statistical difference between Iowa and Nebraska county Extension agriculturalists (mean, 3.20) in this area.

Table 12. Analysis of variance between states regarding teaching methods and instructional tools perceived to be effective by selected county Extension agriculturalists

<table>
<thead>
<tr>
<th>Perceived effectiveness</th>
<th>MS between</th>
<th>MS within</th>
<th>F ratio</th>
<th>F prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questioning(^a)</td>
<td>2.487</td>
<td>.567</td>
<td>4.39</td>
<td>.006*</td>
</tr>
<tr>
<td>Problem solving(^b)</td>
<td>3.503</td>
<td>.631</td>
<td>5.56</td>
<td>.001*</td>
</tr>
<tr>
<td>Tape recorder(^c)</td>
<td>2.914</td>
<td>.970</td>
<td>3.01</td>
<td>.033*</td>
</tr>
<tr>
<td>Pest specimens(^d)</td>
<td>3.610</td>
<td>.769</td>
<td>4.70</td>
<td>.004*</td>
</tr>
<tr>
<td>Workshops(^e)</td>
<td>3.204</td>
<td>.857</td>
<td>3.74</td>
<td>.013*</td>
</tr>
<tr>
<td>Exhibits(^f)</td>
<td>3.547</td>
<td>.861</td>
<td>4.12</td>
<td>.008*</td>
</tr>
<tr>
<td>Self study(^g)</td>
<td>4.138</td>
<td>.690</td>
<td>6.00</td>
<td>.000*</td>
</tr>
</tbody>
</table>

\(^a\)Wisconsin significant at .05 level from Iowa and North Dakota.
\(^b\)Nebraska significant at .05 level from Wisconsin and Iowa.
\(^c\)Iowa significant at .05 level from Nebraska.
\(^d\)Wisconsin significant at .05 level from Iowa.
\(^e\)Wisconsin significant at .05 level from Nebraska and North Dakota.
\(^f\)Wisconsin significant at .05 level from North Dakota.
\(^g\)Wisconsin and Nebraska significant at .05 level from Iowa.

*Significant at .05 level.
There were no other significant differences regarding teaching methods and instructional tools perceived to be effective by selected county Extension agriculturalists.

Perceptions Held Regarding Pesticide Training Programs

Table 13 shows that the mean ratings of the respondents on 9 of the 10 perception statements showed mild agreement. County Extension agriculturalists were somewhat uncertain with respect to the statement, "'Grass roots' organized programs for pesticide training fit local needs". Nine of the statements had standard deviations less than 1.0. The largest standard deviation (1.05) was on the statement, "There is sufficient flexibility for the county Extension professional to modify the pesticide training program."

Statements ranked by mean score were:

1. Federally legislated pesticide training programs have positive effects on the use of pesticides locally.
2. Pesticide training programs are included in the county program planning process.
3. State legislated pesticide training programs have positive effects on the use of pesticides locally.
4. Participants should be given several educational options whereby they can learn and gain knowledge and skills about pesticide management without attending a lecture.
5. There are sufficient up-to-date quality materials to conduct pesticide training in my county.

6. There is sufficient flexibility for the county Extension professional to modify the pesticide training program.

7. Pesticide applicator training should continue in my county in its present form.

8. Current training of the pesticide trainers is adequate to meet the needs of the program.

9. There has been significant change in pesticide usage in my county as a result of the pesticide training program.

10. "Grass roots" organized programs for pesticide training fit local needs.

Table 13. Means and standard deviations of perceptions held by selected county Extension agriculturalists regarding the pesticide training program

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federally legislated pesticide training programs have positive effects on</td>
<td>137</td>
<td>3.93</td>
<td>.77</td>
</tr>
<tr>
<td>the use of pesticides locally.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are sufficient up-to-date quality materials to conduct pesticide</td>
<td>137</td>
<td>3.67</td>
<td>.98</td>
</tr>
<tr>
<td>training in my county.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Grass roots&quot; organized programs for pesticide training fit local needs.</td>
<td>136</td>
<td>3.29</td>
<td>.95</td>
</tr>
</tbody>
</table>
Table 13. continued

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is sufficient flexibility for the county Extension professional to modify the pesticide training program.</td>
<td>137</td>
<td>3.56</td>
<td>1.05</td>
</tr>
<tr>
<td>Pesticide training programs are included in the county program planning process.</td>
<td>136</td>
<td>3.93</td>
<td>0.91</td>
</tr>
<tr>
<td>Participants should be given several educational options whereby they can learn and gain knowledge and skills about pesticide management without attending a lecture.</td>
<td>131</td>
<td>3.68</td>
<td>0.95</td>
</tr>
<tr>
<td>State legislated pesticide training programs have positive effects on the use of pesticides locally.</td>
<td>137</td>
<td>3.72</td>
<td>0.87</td>
</tr>
<tr>
<td>Current training of the pesticide trainers is adequate to meet the needs of the program.</td>
<td>136</td>
<td>3.54</td>
<td>0.89</td>
</tr>
<tr>
<td>There has been significant change in pesticide usage in my county as a result of the pesticide training program.</td>
<td>137</td>
<td>3.50</td>
<td>0.83</td>
</tr>
<tr>
<td>Pesticide applicator training should continue in my county in its present form.</td>
<td>136</td>
<td>3.54</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Scale: 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree

Table 14 shows that selected county Extension agriculturalists in the 4 states surveyed ranged from being in general agreement to general disagreement on the 10 statements listed in Part III of the survey questionnaire.

The first statement, "Federally legislated pesticide training programs have positive effects on the use of pesticides locally", was highly rated by selected county Extension agriculturalists in all 4 states. County
Extension agriculturalists 3 states believed that there were sufficient up-to-date quality materials to conduct pesticide training in their counties. North Dakota county Extension agriculturalists, however, did not believe that there were sufficient up-to-date quality materials to conduct pesticide training in their counties. Three states rated the statement, "'Grass roots' organized programs for pesticide training fit local needs", very low, and North Dakota rated this statement low. Three states rated the statement, "There is sufficient flexibility for the county Extension professional to modify the pesticide training program", low to very low. North Dakota rated this statement very high. Three states rated the statement, "Pesticide training programs are included in the county program planning process", very high, and Wisconsin rated this statement high. Three states rated the statement, "Participants should be given several educational options whereby they can learn and gain knowledge and skills about pesticide management without attending a lecture", low. Iowa rated this statement very high. Three states rated the statement, "State legislated pesticide training programs have positive effects on the use of pesticides locally", high. Nebraska rated this statement very low. Nebraska and Wisconsin county Extension agriculturalists rated the statement, "Current training of the pesticide trainers is adequate to meet the needs of the program", high, while Iowa and North Dakota county Extension agriculturalists rated it low. County Extension agriculturalists in Nebraska, Iowa and North Dakota were somewhat neutral regarding the statement, "There has been significant change in pesticide usage in my county as a result of the pesticide
training program". Wisconsin county Extension agriculturalists rated this statement very low. County Extension agriculturalists in North Dakota, Wisconsin, Nebraska and Iowa were neutral to low in their rating of the statement, "Pesticide applicator training should continue in my county in its present form".

Table 14. Means and standard deviations of perceptions held by county Extension agriculturalists in Iowa, Nebraska, North Dakota and Wisconsin regarding the pesticide training program

<table>
<thead>
<tr>
<th>Statement</th>
<th>Iowa</th>
<th>Nebraska</th>
<th>North Dakota</th>
<th>Wisconsin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federally legislated pesticide training programs have positive effects on the use of pesticides locally.</td>
<td>48 3.96 .65</td>
<td>34 4.03 .72</td>
<td>25 3.84 .90</td>
<td>30 3.87 .90</td>
</tr>
<tr>
<td>There are sufficient up-to-date quality materials to conduct pesticide training in my county.</td>
<td>47 3.75 .85</td>
<td>35 3.94 .84</td>
<td>25 3.12 1.24</td>
<td>30 3.70 .95</td>
</tr>
<tr>
<td>&quot;Grass roots&quot; organized programs for pesticide training fit local needs.</td>
<td>46 3.22 .89</td>
<td>35 3.40 .91</td>
<td>25 3.56 .92</td>
<td>30 3.07 1.08</td>
</tr>
<tr>
<td>There is sufficient flexibility for the county Extension professional to modify the pesticide training program.</td>
<td>47 3.43 1.14</td>
<td>35 3.63 .91</td>
<td>25 3.92 .64</td>
<td>30 3.37 1.27</td>
</tr>
<tr>
<td>Pesticide training programs are included in the county program planning process.</td>
<td>46 4.04 .94</td>
<td>35 3.94 .73</td>
<td>25 4.16 .80</td>
<td>30 3.57 1.07</td>
</tr>
</tbody>
</table>
Table 14. continued

<table>
<thead>
<tr>
<th>Statement</th>
<th>Iowa Mean</th>
<th>Nebraska Mean</th>
<th>North Dakota Mean</th>
<th>Wisconsin Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants should be given several educational options whereby they can learn and gain knowledge and skills about pesticide management without attending a lecture.</td>
<td>46 4.11 .92</td>
<td>31 3.45 .93</td>
<td>24 3.54 .88</td>
<td>30 3.37 .85</td>
</tr>
<tr>
<td>State legislated pesticide training programs have positive effects on the use of pesticides locally.</td>
<td>47 3.85 .63</td>
<td>35 3.40 1.19</td>
<td>25 3.80 .65</td>
<td>30 3.80 .89</td>
</tr>
<tr>
<td>Current training of the pesticide trainers is adequate to meet the needs of the program.</td>
<td>47 3.57 .88</td>
<td>34 3.77 .89</td>
<td>25 3.28 .94</td>
<td>30 3.47 .86</td>
</tr>
<tr>
<td>There has been significant change in pesticide usage in my county as a result of the pesticide training program.</td>
<td>47 3.57 .68</td>
<td>35 3.63 .81</td>
<td>25 3.56 .87</td>
<td>30 3.17 .99</td>
</tr>
<tr>
<td>Pesticide applicator training should continue in my county in its present form.</td>
<td>47 3.49 .86</td>
<td>35 3.57 .82</td>
<td>24 3.71 .69</td>
<td>30 3.47 .94</td>
</tr>
</tbody>
</table>

Scale: 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree

Table 15 shows that only 2 statements out of 10 in Part III of the survey questionnaire were significant statistically when comparing the means of these items. There was a significant statistical difference
between North Dakota (mean, 3.12) and Nebraska county Extension agriculturalists (mean, 3.94) in answering the statement, "There are sufficient up-to-date quality materials to conduct pesticide training in my county." There was a highly significant statistical difference between Wisconsin (mean, 3.37) and Iowa county Extension agriculturalists (mean, 4.11), and a significant statistical difference between Nebraska (mean, 3.34) and Iowa county Extension agriculturalists in answering the statement, "Participants should be given several educational options whereby they can learn and gain knowledge and skills about pesticide management without attending a lecture."

Table 15. Analysis of variance between states of perceptions held regarding the pesticide training program

<table>
<thead>
<tr>
<th>Statement.</th>
<th>MS between</th>
<th>MS within</th>
<th>F ratio</th>
<th>F prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are sufficient up-to-date quality materials to conduct pesticide training in my county.</td>
<td>3.486</td>
<td>.901</td>
<td>3.87</td>
<td>.011*</td>
</tr>
<tr>
<td>Participants should be given several educational options whereby they can learn and gain knowledge and skills about pesticide management without attending a lecture.</td>
<td>4.492</td>
<td>.812</td>
<td>5.54</td>
<td>.001*</td>
</tr>
</tbody>
</table>

*Significant at .05 level.
Comparison of Perceptions, Use and Effectiveness of Instructional Methods/Tools Based on Selected Demographic Data

There were no significant differences found in Part I of the questionnaire (perceptions held regarding principles of teaching-learning) when analysis of variance statistical tests (alpha = .05) were run on: age, years of formal teaching experience, and years of Extension Service employment.

Data of the 3 county Extension agriculturalists with doctorates were combined with those holding master's degrees. Table 16 shows that county Extension agriculturalists with advanced degrees were in stronger agreement statistically (alpha = .05) than those with bachelor's degrees that, "In teaching proper pesticide use, environmental concerns, and safety, county Extension agriculturalists should possess the relevant and required teaching ability and skills". County Extension agriculturalists with bachelor's degrees felt more strongly than those with advanced degrees that, "In teaching proper pesticide use, environmental concerns, and safety, county Extension agriculturalists should prepare and use self-directed teaching-learning aids". The means of all other items were not found to be significantly different based on level of education.
Table 16. Comparisons of means and standard deviations of perceptions held regarding principles of teaching-learning based on level of education

| In teaching proper pesticide use, etc., county Extension agriculturalists should: | Bachelor degree | Advanced degree | t value | prob. | n | Mean | S.D. | n | Mean | S.D. | t value | prob. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Possess the relevant and required teaching ability and skills. | 38 | 4.21 | .66 | 96 | 4.47 | .58 | -2.23 | .027* |
| Prepare and use self-directed teaching-learning aids. | 36 | 3.67 | .86 | 96 | 3.33 | .83 | 2.03 | .044* |

Scale: 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree

*aCounty Extension agriculturalists with masters or doctorate degrees.

*Significant at .05 level.

Table 17 shows that there was a significant statistical difference (alpha = .05) between 50 to 59 (mean, 1.19) and 60-plus-year-old county Extension agriculturalists (mean, 1.08) and 20 to 29-year-old county Extension agriculturalists (mean, 2.25) in using computer aided instruction as an instructional method. These data indicate that older county Extension professionals were less likely to use the computer as an instructional method in pesticide training.

There was a significant statistical difference (alpha = .05) between 60-plus-year-old county Extension agriculturalists (mean, 1.92) and 20 to 29-year-old county Extension agriculturalists (mean, 3.75) in using newsletters as an instructional method. Younger county Extension
professionals indicated a higher preference towards using newsletters as an instructional method in pesticide training.

There were no other significant differences regarding the use of instructional methods and teaching tools based on age.

There were no significant statistical differences in the use or effectiveness ratings with respect to years of formal teaching experience by county Extension agriculturalists.

Table 17. Analysis of variance of means based on age groups regarding use of teaching methods and instructional tools

<table>
<thead>
<tr>
<th>Item</th>
<th>MS between</th>
<th>MS within</th>
<th>F ratio</th>
<th>F prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer aided instructiona</td>
<td>2.635</td>
<td>.566</td>
<td>4.66</td>
<td>.002*</td>
</tr>
<tr>
<td>Newslettersb</td>
<td>6.490</td>
<td>1.452</td>
<td>4.47</td>
<td>.002*</td>
</tr>
</tbody>
</table>

a50 to 59 and 60 years old-plus age groups significant at .05 level from 20 to 29 year-old age group.
b20 to 29 age group significant from 60 plus age group.
*Significant at .05 level.

Table 18 shows that there was a significant statistical difference (alpha = .05) between county Extension agriculturalists with 6 to 10 (mean, 1.17) and 21 to 25 years of Extension employment (mean, 1.22) and county Extension agriculturalists with less than 1 year of service (mean, 2.20) in using the flannel board as an instructional tool. There was a highly significant statistical difference (alpha = .01) between county Extension agriculturalists with 11 to 15 (mean, 1.05) and 26 plus years of service (mean, 1.07) and county Extension agriculturalists with less than
1 year of service (mean, 2.20) in using the flannel board as an educational tool. Newly employed county Extension agriculturalists appeared to be more receptive to using the flannel board as an instructional tool.

No other items were found to be significantly different based on years of employment.

Table 18. Analysis of variance of means based on years of Extension Service employment and teaching methods and instructional tools used

<table>
<thead>
<tr>
<th>Item</th>
<th>MS between</th>
<th>MS within</th>
<th>F ratio</th>
<th>F prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Extent of use)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flannel board&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.125</td>
<td>.258</td>
<td>4.36</td>
<td>.000&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Employees with less than 1 year of service significant at the .05 level from those with 6 to 10 years and 21 to 25 years of Extension service.  
<sup>*</sup>Significant at .05 level.

Table 19 shows that there was a significant statistical difference between: (1) county Extension agriculturalists with a bachelor's degree and those with an advanced degree in using role playing as a teaching method; (2) county Extension agriculturalists with an advanced degree and those with a bachelor's degree in using instructional posters as a teaching method; (3) county Extension agriculturalists with a bachelor's degree and those with an advanced degree in using tape recorders as an instructional tool; and, (4) county Extension agriculturalists with an advanced degree and those with a bachelor's degree in using newsletters as a teaching method.
No other items showed significant differences in use based on level of education.

Table 19. Comparisons of means and standard deviations of perceptions of county Extension agriculturalists with respect to the use of teaching methods and instructional tools

<table>
<thead>
<tr>
<th>Item</th>
<th>Bachelors</th>
<th>Advanced</th>
<th>t value</th>
<th>t prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>degree</td>
<td>degree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role playing</td>
<td>38</td>
<td>94</td>
<td>-2.18</td>
<td>.031*</td>
</tr>
<tr>
<td></td>
<td>1.13</td>
<td>1.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.34</td>
<td>.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional posters</td>
<td>38</td>
<td>94</td>
<td>2.17</td>
<td>.032*</td>
</tr>
<tr>
<td></td>
<td>2.34</td>
<td>1.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.24</td>
<td>.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tape recorder</td>
<td>38</td>
<td>94</td>
<td>-2.32</td>
<td>.022*</td>
</tr>
<tr>
<td></td>
<td>2.87</td>
<td>3.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.44</td>
<td>1.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newsletters</td>
<td>38</td>
<td>94</td>
<td>2.11</td>
<td>.036*</td>
</tr>
<tr>
<td></td>
<td>3.11</td>
<td>2.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.11</td>
<td>1.31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1 = not used, 2 = rarely used, 3 = sometimes used, 4 = frequently used, 5 = heavily used

*Significant at .05 level.

Table 20 shows that there was a significant statistical difference between county Extension agriculturalists with a bachelor's degree and those with an advanced degree in perceived use of the tape recorder as an instructional tool. County Extension agriculturalists with advanced degrees rated it higher in perceived effectiveness.

There was a highly significant statistical difference between county Extension agriculturalists with an advanced degree and those with a
bachelor's degree in perceived use of the satellite as an instructional tool. County Extension agriculturalists with a bachelor's degree rated it higher in perceived effectiveness.

All other effectiveness items were not found to be significantly different when compared on the basis of educational level.

Table 20. Comparison of means and standard deviations regarding the perceived effectiveness of selected teaching methods and instructional tools based on level of education.

<table>
<thead>
<tr>
<th>Item</th>
<th>Bachelors degree</th>
<th>Advanced degree</th>
<th>t</th>
<th>t prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
<td>S.D.</td>
<td>n</td>
</tr>
<tr>
<td>Tape recorder</td>
<td>35</td>
<td>2.97</td>
<td>1.04</td>
<td>92</td>
</tr>
<tr>
<td>Satellite</td>
<td>29</td>
<td>3.45</td>
<td>.69</td>
<td>81</td>
</tr>
</tbody>
</table>

Scale: 1 = not effective, 2 = of little effectiveness, 3 = somewhat effective, 4 = effective, 5 = very effective

*Significant at .05 level.

There were no significant differences found in Part II of the questionnaire (teaching methods and instructional tools used and perceived to be effective) when analysis of variance statistical tests were run on years of formal teaching experience.

There were no significant differences found in Part III of the questionnaire (perceptions held regarding the pesticide training program) when analysis of variance statistical tests at the .05 level were
conducted on age, years of formal teaching experience, and years of Extension service employment.

Table 21 shows that county Extension agriculturalists with a bachelor's degree were more in agreement in answering the statement, "There is sufficient flexibility for the county Extension professional to modify the pesticide training program", than were those with an advanced degree. This statement was highly significant statistically (alpha = .01).

County Extension agriculturalists with an advanced degree were more in agreement in answering the statement, "Current training of the pesticide trainers is adequate to meet the needs of the program", than were those with a bachelor's degree. This statement was significant statistically (alpha = .05).
Table 21. Comparisons of means and standard deviations regarding perceptions held regarding the pesticide training program based on level of education

<table>
<thead>
<tr>
<th>Statement</th>
<th>Bachelor degree</th>
<th>Advanced degree</th>
<th>t value</th>
<th>prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is sufficient flexibility for the county Extension professional to modify the pesticide training program.</td>
<td>38 3.92 .75</td>
<td>98 3.41 1.12</td>
<td>3.09</td>
<td>.003*</td>
</tr>
<tr>
<td>Current training of the pesticide trainers is adequate to meet the needs of the program.</td>
<td>38 3.24 .94</td>
<td>97 3.66 .85</td>
<td>-2.52</td>
<td>.013*</td>
</tr>
</tbody>
</table>

Scale: 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree

*Significant at .05 level.

Selected Comments from the Respondents

The following list represents a summary of the respondents comments, which were written on Part V of the questionnaire.

"I feel that the private pesticide training has been a good thing for Extension."
"We have made some contacts we haven't had otherwise."
"We do need to constantly update the teaching material."
"Spend more time on sprayer calibration."
"Large audiences reduce greatly the effectiveness of training and teaching options. This is our single greatest problem."
"Variety of teaching methods and media techniques helps avoid boredom."
"These programs are an important part of our overall responsibility, but are only one part."
"The training could be done over the satellite system and video recorded for individual check-out."
"This has been an effective program that gives the Extension Service good visibility locally."
"Staff need to be up-to-date on pesticide awareness issues."
"Our challenge as teachers is to make all modes of learning as interesting, factual, and growth-oriented as possible."
"...the injection of more motivating teaching methods would severely curtail the content covered."
"Perhaps it would be wise to include an educational specialist in organizing the package program, rather than just relying on subject matter specialists."
"Weed and insect identification kits would be useful."
"Could use more worksheets and other hands-on participation exercises."
"We have had a very positive experience with pesticide training."
"Clientele are very positive about Extension pesticide programs. Evaluations support this."
"Need to provide options for study so clientele can choose best one for them."
"Gradually increase the difficulty of the exam."
"Clientele's attitudes concerning training are more positive than some staff."
"Continue to update and change materials and methods at least every three years."
"Too much duplication. Remove "fat" and "wordage" from program."
"Possibly design pesticide applicator training to fit into our program of work and develop a series of meetings using a variety of teaching methods."
"State required subject matter presentations do not allow much
flexibility in teaching process."
"We need to learn to set up objectives of meetings and training
programs."
"We do need to work on our image."
"I don't think we need to spend a lot of time evaluating teaching
methods."
"I think it's a great program and a real educational tool. It's too bad
we don't have similar tools for all subject matter we teach."
"Should use more specimens and hands-on items where possible.
...helps to vary the techniques/methods."
"It would really be nice to use a larger selection of teaching
methods and tools, but time is a limiting factor. Too much material
to cover at one time! The training manual is a very good tool for
most learners."
"More "problem solving" materials and test questions would be
helpful."
"An agent's time is very limited to do individualized teaching and to
use some of the other educational tools."
"Many do not want to take time to attend a training session. Home
study packets have helped."
"Private applicator training gives me an opportunity to contact and
work with a number of non-Extension users on a regular basis."
Pesticide applicator training has done a great deal to enhance the
overall image of Extension."
"Continuous updating of training materials is necessary."
"Quality of training is dependent on the person in charge and
his/her attitude."
"The enthusiasm and attitude of the county agent can make a
program successful, even if unproven teaching methods were used."
"I treat pesticide training as something I have to do and I add very
little to the presentation."
"We could have a more effective educational program by using
better teaching methods."
"Most of the training is with tape-slide sets and it can get boring without some localized information."
"Possibly could add some variety to delivery methods."
"Producers are willing to accept the training if the instructor has a positive attitude about the training."
"Training should be presented as a very positive program and with sound objectives."
"This is an excellent teaching opportunity which should result in a positive learning experience."
"Present program does not allow sufficient flexibility to adjust for current needs nor individual learner needs."
"Pesticide applicator training could be broadcast via satellite or public TV (in non-prime time), to be taped on video cassette recorders."
"Learning to recite facts is one thing ... feeling the importance to apply and put into practice is the true test."

County Extension agriculturalists surveyed exhibited, for the most part, a positive attitude towards pesticide applicator training. They commented that large audiences, a large volume of subject matter to cover, and time constraints limited the variety of teaching methods and instructional tools that could be used to facilitate the teaching-learning process. Participants also indicated that clear educational objectives and addition of an education specialist to the state program planning team would serve to improve the program. Private pesticide applicator training programs are evaluated and clientele have a positive attitude towards the private pesticide applicator program.
CHAPTER V. DISCUSSION

The purpose of this study was to identify and assess the educational delivery systems used by county Extension agriculturalists in Iowa, Nebraska, North Dakota, and Wisconsin to train private pesticide applicators.

With respect to pesticide applicator training, the objectives of this study were to:

1. Identify demographic characteristics of county agricultural Extension professionals.
2. Identify perceptions held by county agricultural Extension professionals regarding principles of teaching-learning.
3. Identify teaching methods and instructional tools used and perceived to be effective by county agricultural Extension professionals in conducting pesticide training programs.
4. Identify perceptions held by county agricultural Extension professionals regarding the pesticide training program.
5. Compare perceptions and use of instructional methods/tools based on selected demographic data.

The research design was determined to be adequate for obtaining data from county Extension agriculturalists in four states that would allow generalizations to be made with respect to the purpose and objectives of this study. The survey instrument's high Cronbach alpha scores for each part of the survey instrument and the high overall score suggested that all items related well to each other.
The discussions are presented in the following sections:

1. Discussion Relevant to Demographic Information
2. Discussion Relevant to Principles of Teaching-Learning
3. Discussion Relevant to Teaching Methods and Instructional Tools
4. Discussion Relevant to Pesticide Training Program
5. Discussion Relevant to Perceptions and Teaching Methods/Instructional Tools Based on Selected Demographic Data

Discussion Relevant to Demographic Information

A discussion is presented in this section relevant to demographic information. Objective 1 of the study was to identify demographic characteristics of county agricultural Extension professionals. To facilitate analysis of demographic data the following research question was asked: What are the major demographic characteristics of county Extension agricultural professionals? The findings were:

1. County Extension agriculturalists in the 4 states surveyed were mostly male (97.0%).
2. A majority of those surveyed were 40 years-old-or-older (66.2%) and one-third (33.8%) were 50 years-old-or-older.
3. Fifty-five of the survey participants (40.1%) reported having from 1 to 10 years of formal teaching experience. Only 26.3% reported having no formal teaching experience prior to employment with the Extension Service.
4. Eighty-one county Extension agriculturalists (58.3%) reported having from 1 to 15 years of employment with the Extension Service. Twenty-nine (20.9%) listed 26-years-plus of Extension Service employment. In this area, Iowa had the highest percentage (27.1%) and Wisconsin the lowest (9.6%).

5. Ninety-five county Extension agriculturalists (68.8%) reported having a master's degree and 3 (2.2%) had a doctorate. Wisconsin had the highest number of county Extension agriculturalists with advanced degrees (master's and/or doctorate) (93.3%), followed by Nebraska (91.7%), Iowa (63.8%), and North Dakota (28.0%).

The findings suggest that the average county Extension agriculturalist surveyed in the 4 states was male, in his forties, had some formal teaching experience, was about mid-career, and had a master's degree. Advanced degrees have been required by Extension administration of county Extension agriculturalists, since farmers with interest in more education are also highly educated (Martin, 1987).

Discussion Relevant to Principles of Teaching-Learning

A discussion is presented in this section relevant to principles of teaching-learning. Objective 2 of the study was to identify perceptions held by county agricultural Extension professionals regarding principles of teaching-learning. To facilitate analysis of principles of teaching-learning data the following research question was asked: What
perceptions do county Extension professionals hold regarding the principles of teaching-learning?

Those county Extension agriculturalists surveyed indicated agreement to strong agreement (mean range from 4.04 to 4.65) on 10 teaching-learning principles. Standard deviations were less than .76 (range from .49 to .75). These 10 teaching-learning principles were:

1. Prepare a comfortable and non-threatening teaching-learning environment.
2. Use a variety of instructional methods.
3. Recognize that individual differences exist among learners.
4. Possess the relevant and required teaching ability and skills.
5. Clarify the program objectives to learners.
6. Identify and use educational principles and procedures in teaching.
7. Use decision making situations in teaching.
8. Develop and use a definite and specific interest approach to enhance the learner's motivation.
9. Evaluate the product of the teaching-learning situation (i.e., subject matter learned).
10. Evaluate the teaching-learning process.

The remaining 7 teaching-learning principles had mean scores ranging from 3.99 (agree) to 3.36 (uncertain). The standard deviation range was from .85 to 1.03. These 7 teaching-learning principles were:

1. Be knowledgeable in each subject matter area taught.
2. Prepare instructional plans designed to enhance the teaching-learning process.

3. Use a variety of evaluation procedures.

4. Use group instruction in dealing with specific problems.

5. Prepare and use self-directed teaching-learning aids.

6. Use individualized instruction to help learners solve problems.

7. Involve learners in the program planning process.

County Extension agriculturalists surveyed indicated an awareness of the value of andragogical teaching-learning principles which have been outlined by Knox (1987) and other educators. But, have they used these teaching-learning principles in private pesticide training? The researcher believes that the answer to this question is no. County Extension agriculturalists do not use a variety of teaching-learning principles in private pesticide training.

County Extension agriculturalists commented on the returned questionnaires that private pesticide training was only one of many programming responsibilities. Therefore, they may feel they have little time to prepare teaching-learning aids or use individualized instruction as a teaching method. Since the private pesticide program has been mandated by state and Federal legislation, they may have seen no need to involve learners in the program planning process. Other comments returned with the questionnaire indicated that audience size, delivery time and subject matter constraints may have caused county Extension agriculturalists to use a limited number of teaching methods and
instructional tools in private pesticide training. Martin and Omer (1988) indicated that the lecture-discussion method was the predominate instructional strategy used by Extension professionals in Iowa, with the overhead projector and 33 mm slide projector being the instructional tools most often used. This teaching method is instructor-centered. Communication is mostly one way and student response is normally passive. Learning is facilitated by active student participation (Weston and Cranton, 1986).

In private pesticide training, the researcher believes that county Extension agriculturalists often do not: (1) use a variety of instructional methods, (2) identify and use educational principles and procedures in teaching, (3) use a variety of decision making situations in teaching, (4) develop and use a definite and specific interest approach to enhance the learner's motivation, (5) evaluate the teaching-learning process, (6) prepare instructional plans designed to enhance the teaching-learning process, (7) use a variety of evaluation procedures, (8) prepare and use self-directed teaching-learning aids, and (9) use individualized instruction to help learners solve problems.

Two perceived principles of teaching-learning were statistically significantly different (at the .05 level) between states. County Extension agriculturalists in North Dakota rated "Evaluate the teaching-learning process" lower in mean score (3.67) than Nebraska (3.94), and statistically lower in mean score than either Iowa (4.17) or Wisconsin (4.26). County Extension agriculturalists in Wisconsin rated "Evaluating the product of the teaching-learning situation (i.e., subject matter
learned)" higher in mean score (4.36) than Iowa (4.17) and statistically higher than either Nebraska (3.82) or North Dakota (3.75). This difference between states may reflect the leadership and guidance of Extension administration in providing staff training in program evaluation, and in perceived importance of program evaluation. Patton (1983) stated that evaluation of a program's process and product should not be viewed by Extension workers as something alien, threatening, or unknown.

Discussion Relevant to Teaching Methods and Instructional Tools

A discussion is presented in this section relevant to teaching methods and instructional tools. Objective 3 of the study was to identify teaching methods and instructional tools used and perceived to be effective by county agricultural Extension professionals. To facilitate analysis of data, four research questions were asked.

The first research question was: What teaching methods are predominantly used and perceived to be effective by county Extension professionals?

The six teaching methods frequently used to sometimes used by county Extension agriculturalists in private pesticide training are (rated from high to low): (1) lecture-discussion, (2) questioning, (3) lecture, (4) news stories, (5) problem solving, and (6) self study. Teaching methods rarely used or not used by county Extension agriculturalists were (rated from high to low): (1) panel discussion, (2) brainstorming, (3) computer
aided instruction, (4) buzz groups, and (5) role playing. These findings agreed with a study made by Martin and Omer (1988).

Iowa county Extension agriculturalists did not use the teaching method "group discussion" as much as the other 3 states, and there was a highly significant statistical difference (alpha = .01) between Iowa (mean, 2.59) and Wisconsin county Extension agriculturalists (mean, 3.43) on this item.

Wisconsin county Extension agriculturalists occasionally used "questioning" as a teaching method (mean, 2.86). Their response was significantly different statistically (alpha = .05) from that of Nebraska (mean, 3.53) and North Dakota county Extension agriculturalists (mean, 3.58), who frequently used this teaching method.

There was a highly significant statistical difference (alpha = .01) between Iowa (mean, 1.98) and North Dakota county Extension agriculturalists (mean, 3.21) in using "video tape programs" as a teaching method.

There was a significant statistical difference (alpha = .05) between Iowa (mean, 2.93) and North Dakota county Extension agriculturalists (mean, 3.72) in using "news stories" as a teaching method.

There was a highly significant statistical difference (alpha = .01) between Iowa (mean, 2.21) and North Dakota county Extension agriculturalists (mean, 3.46) in using "workshops" as a teaching method.

There was a highly significant statistical difference (alpha = .01) between Wisconsin (mean, 2.71) and Iowa county Extension agriculturalists (mean, 3.66) in using "self study" as a teaching method.
Statistical differences between states regarding teaching methods may reflect the extent of training that county Extension agriculturalists have received in teaching methods and the availability of teaching methods (for example, self study aids and video tape programs) for use in private pesticide programs.

Weston and Cranton (1986) defined "teaching method" as the vehicle or technique for instructor-student communication. Private pesticide training in the 4 states surveyed appeared to be mostly instructor-centered (lecture, questioning, and demonstration), where the teacher conveys information to a group of students. Communication - using the instructor-centered teaching method - is mostly one way and student response is normally passive. Brookfield (1987) stated that it is naive to assume that learning is being facilitated simply because adults are under the direction of a teacher. A mass lecture to an adult audience in which there is no opportunity for discussion, questioning, exchange of differing viewpoints, or an attempt to link the learners' experiences with the topic under discussion is poor teaching practice. Use of a variety of teaching methods in private pesticide training would greatly improve the teaching-learning transaction.

The second research question was: What instructional tools are predominantly used and perceived to be effective by county Extension professionals?

The three instructional tools frequently used to sometimes used by county Extension agriculturalists in private pesticide training were (rated from high to low): (1) 35 mm slides, (2) overhead projector, and (3) tape
recorder. Instructional tools rarely or not used by county Extension agriculturalists included the satellite and the flannel board. These findings agreed with a study made by Martin and Omer (1988).

Iowa county Extension agriculturalists rarely used the "tape recorder" as an instructional tool (mean, 2.40), when compared to the other 3 states. This difference was significant statistically (alpha = .05) from North Dakota (mean, 3.46) and highly significant statistically (alpha = .01) from Wisconsin (mean, 3.64) and Nebraska county Extension agriculturalists (mean, 4.17). This finding may mean that Wisconsin and Nebraska county Extension agriculturalists used a greater variety of instructional tools in private pesticide training.

There was a significant statistical difference (alpha = .05) between North Dakota (mean, 1.09) and Iowa county Extension agriculturalists (mean, 1.76) in using the "satellite" as an instructional tool. This finding may indicate that the satellite was not available as an instructional tool in some states, and the low mean scores indicated little or no use as an instructional tool in private pesticide training in any of the 4 states surveyed.

There was a significant statistical difference (alpha = .05) between Nebraska (mean, 3.06) and Iowa county Extension agriculturalists (mean, 3.86) in using the "overhead projector" as an instructional tool. This finding may indicate that Nebraska county Extension agriculturalists used a greater variety of instructional tools in private pesticide training.

There was a significant statistical difference (alpha = .05) between Wisconsin (mean, 4.10) and Iowa county Extension agriculturalists (mean,
4.73) in using "35 mm slides" as an instructional tool. This finding may indicate that Iowa county Extension agriculturalists extensively used 35 mm slides as an instructional tool in private pesticide training.

There was a significant statistical difference (alpha = .05) between Iowa (mean, 1.86) and North Dakota county Extension agriculturalists (mean, 2.71) in using "pest specimens" as an instructional tool. This finding may reflect the relative availability of pest specimens as an instructional tool in some states for private pesticide training.

Statistical differences between states regarding instructional tools may reflect the extent of training that county Extension agriculturalists have received in instructional tools and the availability of instructional tools (examples: satellite and pest specimens) for use in private pesticide programs.

The third research question was: What teaching methods are thought to be potentially effective by county Extension professionals?

The nine teaching methods perceived to be effective to somewhat effective by county Extension agriculturalists in private pesticide training are (rated from high to low): (1) demonstration, (2) individual instruction, (3) problem solving, (4) lecture-discussion, (5) group discussion, (6) video tape programs, (7) questioning, (8) workshops, and (9) tours. Teaching methods perceived to be of little effectiveness included buzz groups and role playing. Knox (1987) stated that the satisfaction and knowledge gained from the teaching-learning experience depends on use of teaching methods such as: (1) effective use of questions and examples, (2) provision for practice opportunities, (3)
sequence of activities for orderly progression, (4) satisfactory pacing, (5) positive reinforcement, and (6) program evaluation that provides effective feedback for both the teacher and the learner.

There was a significant statistical difference (alpha = .05) between Wisconsin (mean, 3.25) and Iowa (mean, 3.79) and North Dakota county Extension agriculturalists (mean, 3.96) in perceived effectiveness of using "questioning" as a teaching method.

There was a significant statistical difference (alpha = .05) between Nebraska (mean, 3.33) and Wisconsin county Extension agriculturalists (mean, 4.00) and a highly significant statistical difference (alpha = .01) from Iowa county Extension agriculturalists (mean, 4.02) in perceived effectiveness of using "problem solving" as a teaching method.

There was a statistically significant difference (alpha = .05) between Wisconsin (mean, 3.12) and Nebraska (mean, 3.84) and North Dakota county Extension agriculturalists (mean, 3.90) in perceived effectiveness of using "workshops" as a teaching method.

There was a significant statistical difference (alpha = .05) between Wisconsin (mean, 2.64) and North Dakota county Extension agriculturalists (mean, 3.55) in perceived effectiveness of using "exhibits" as a teaching method.

There was a significant statistical difference (alpha = .05) between Wisconsin (mean, 3.29) and Iowa county Extension agriculturalists, and a highly significant statistical difference (alpha = .01) between Nebraska (mean, 3.20) and Iowa county Extension agriculturalists (mean, 3.93) in perceived effectiveness of using "self study" as a teaching method.
County Extension agriculturalists surveyed seemed to understand the value of using a variety of effective teaching methods in private pesticide training. But, due to the amount of subject matter to be covered, size of learner audience, and time constraints, apparently most county Extension agriculturalists surveyed used an instructor-centered teaching method. Interactive teaching methods work best with small classes and take more time to plan. Learning is facilitated by active student participation (Weston and Cranton, 1986). Interactive teaching methods favor the two distinguishing characteristics of adult learning, which are: (1) the adult's autonomy of direction in the act of learning and, (2) the use of personal experience as a learning resource (Brookfield, 1987).

The fourth research question was: What instructional tools are thought to be potentially effective by county Extension professionals?

The three instructional tools perceived to be effective by county Extension agriculturalists in private pesticide training are (from high to low in mean score): (1) 35 mm slides, (2) pest specimens and (3) the overhead projector. Instructional tools perceived to be somewhat effective by county Extension agriculturalists include the satellite and the flannel board.

There was a significant statistical difference (alpha = .05) between Iowa (mean, 2.88) and Nebraska county Extension agriculturalists (mean, 3.53) in perceived effectiveness of using a tape recorder as an instructional tool.
There was a significant statistical difference (alpha = .05) between Wisconsin (mean, 3.30) and Iowa county Extension agriculturalists (mean, 4.05) in perceived effectiveness of using pest specimens as an instructional tool.

In summary, county Extension agriculturalists listed 35 mm slides as the most frequently used teaching tool, followed by the overhead projector. The highest rated methods by mean score were; lecture-discussion, questioning, and lecture. Perceived effectiveness for these educational tools and methods were rated lower than actual use. With the exception of tours, satellite, individualized instruction, video tape programs, motion pictures, television, and flannel board, moderate to low positive correlation was found between extent of use and perceived effectiveness for the other 25 listed teaching methods and instructional tools. Both "tours" and "satellite" were rated higher by mean score in perceived effectiveness (from rarely used to somewhat effective).

Teaching methods and instructional tools rarely used by county Extension agriculturalists but rated to be somewhat effective in perceived effective use included buzz groups, role playing, and the flannel board.

These findings suggest that county Extension agriculturalists recognized the potential value of using a variety of teaching methods and instructional tools in private pesticide training. The results indicate that if county Extension agriculturalists were trained and proficient in the use of a variety of teaching methods and instructional tools, and if the instructional tools were available, county Extension agriculturalists would
readily use a greater variety of instructional methods and teaching tools in private pesticide programming.

Discussion Relevant to Pesticide Training Program

A discussion is presented in this section relevant to the pesticide training program. Objective 4 of the study was to identify perceptions held by county agricultural Extension professionals regarding the pesticide training program. To facilitate analysis of data, the following research question was asked: What perceptions do county Extension professionals hold regarding the pesticide training program?

The mean ratings of these county Extension agriculturalists on 9 of the 10 statements showed mild agreement. County Extension agriculturalists were uncertain with respect to the statement, "'Grass roots' organized programs for pesticide training fit local needs". Nine of the statements addressed had standard deviations less than 1.0. The largest standard deviation (1.05) was on the statement, "There is sufficient flexibility for the county Extension professional to modify the pesticide training program."

Statements placed in rank order by mean score were:

1. Federally legislated pesticide training programs have positive effects on the use of pesticides locally.
2. Pesticide training programs are included in the county program planning process.
3. State legislated pesticide training programs have positive effects on the use of pesticides locally.

4. Participants should be given several educational options whereby they can learn and gain knowledge and skills about pesticide management without attending a lecture.

5. There are sufficient up-to-date quality materials to conduct pesticide training in my county.

6. There is sufficient flexibility for the county Extension professional to modify the pesticide training program.

7. Pesticide applicator training should continue in my county in its present form.

8. Current training of the pesticide trainers is adequate to meet the needs of the program.

9. There has been significant change in pesticide usage in my county as a result of the pesticide training program.

10. "Grass roots" organized programs for pesticide training fit local needs.

There was a significant difference statistically (alpha = .05) between North Dakota county Extension agriculturalists (mean, 3.12) and Nebraska county Extension agriculturalists (mean, 3.94) in answering the statement, "There are sufficient up-to-date quality materials to conduct pesticide training in my county".

There was a highly significant statistical difference (alpha = .01) between Wisconsin county Extension agriculturalists (mean, 3.37) and Iowa county Extension agriculturalists (mean, 4.11), and a difference
statistically (alpha = .05) between Nebraska county Extension agriculturalists (mean, 3.34) and Iowa county Extension agriculturalists in answering the statement, "Participants should be given several educational options whereby they can learn and gain knowledge and skills about pesticide management without attending a lecture".

These findings suggest that the county Extension agriculturalists surveyed had a positive attitude with respect to private pesticide training. This finding was supported by the selected comments from the questionnaire. Since the private pesticide program has been mandated by state and Federal legislation, county Extension agriculturalists were uncertain about the statement that "grass roots" organized programs for pesticide training fit local needs. The findings also suggested that there were major differences between the 4 states in implementing the private pesticide training program. These differences were:

1. North Dakota county Extension agriculturalists were uncertain about there being sufficient up-to-date quality materials in their state to conduct pesticide training. Other states agreed with this statement, and there was a statistical difference (alpha = .05) between North Dakota and Nebraska county Extension agriculturalists.

2. Iowa county Extension agriculturalists agreed with the statement that participants should be given several educational options to learn and gain knowledge and skills about pesticide management without attending a lecture. Their response was significantly different statistically (alpha =
.05) from Nebraska county Extension agriculturalists (uncertain) and highly significant statistically (alpha = .01) from Wisconsin county Extension agriculturalists (uncertain).

3. North Dakota county Extension agriculturalists agreed that there was sufficient flexibility to modify the pesticide training program. County Extension agriculturalists in Iowa, Nebraska and Wisconsin showed less agreement on this statement.

4. Nebraska county Extension agriculturalists were uncertain that state legislated pesticide training programs had positive effects on the use of pesticides locally. County Extension agriculturalists in the other 3 states were somewhat in agreement with this statement.

5. Wisconsin county Extension agriculturalists were uncertain that there had been significant change in pesticide usage as a result of the pesticide training program. County Extension Agriculturalists in the other 3 states slightly agreed with this statement.

In summary, differences shown by selected county Extension agriculturalists between the 4 states surveyed, with respect to perceptions regarding private pesticide training, may reflect the attitudes and organizational policy of state legislators and state Extension administrators.
Discussion Relevant to Perceptions and Teaching Methods/Instructional Tools Based on Selected Demographic Data

A discussion is presented in this section relevant to perceptions and instructional methods/teaching tools based on selected demographic data. Objective 5 of the study was to compare perceptions, use of instructional methods/tools based on selected demographic data. To facilitate analysis of data the following research question was asked: What comparisons can be made of the perceptions, teaching methods, and instructional tools based on selected demographic variables?

There were no significant differences found in Part I of the questionnaire (perceptions held regarding principles of teaching-learning) when analysis of variance statistical tests (alpha = .05) were run on: age, years of formal teaching experience, and years of Extension Service employment. Data of the 3 county Extension agriculturalists with doctorate degrees were added to those holding master's degrees to form an advanced degree data set.

County Extension agriculturalists with advanced degrees were in stronger agreement statistically (alpha = .05) than those with bachelor's degrees that in teaching proper pesticide use, environmental concerns, and safety county Extension agriculturalists should possess the relevant and required teaching ability and skills. County Extension agriculturalists with bachelor's degrees felt more strongly than those with advanced degrees that in teaching proper pesticide use, environmental concerns, and safety county Extension agriculturalists should prepare and use self-directed teaching-learning aids.
There was a significant statistical difference (alpha = .05) between 50 to 59 (mean, 1.19) and 60-plus-year-old county Extension agriculturalists (mean, 1.08) and 20 to 29-year-old county Extension agriculturalists (mean, 2.25) in using computer aided instruction as an instructional method. These data indicated that older county Extension professionals were less likely to use the computer as an instructional tool in pesticide training.

There was a significant statistical difference (alpha = .05) between 60-plus-year-old county Extension agriculturalists (mean, 1.92) and 20 to 29-year-old county Extension agriculturalists (mean, 3.75) in using newsletters as an instructional method. Younger county Extension professionals indicated a stronger preference towards using newsletters as a teaching method in pesticide training.

There was no statistically significant difference with respect to years of formal teaching experience by county Extension agriculturalists.

There was a significant statistical difference (alpha = .05) between county Extension agriculturalists with 6 to 10 (mean, 1.17) and 21 to 25 years of Extension employment (mean, 1.22) and county Extension agriculturalists with less than 1 year of service (mean, 2.20) in using the flannel board as an instructional tool. There was a highly statistically significant difference (alpha = .01) between county Extension agriculturalists with 11 to 15 (mean, 1.05) and 26 plus years of service (mean, 1.07) and county Extension agriculturalists with less than 1 year of service (mean, 2.20) in using the flannel board as an instructional tool.
Newly employed county Extension agriculturalists appeared to be more receptive to using the flannel board as an instructional tool.

There was a significant statistical difference (alpha = .05) between county Extension agriculturalists with a bachelor's degree (not used) and those with an advanced degree (rarely used) in using role playing as a teaching method. County Extension agriculturalists with advanced degrees may have received more training in interactive teaching methodology.

There was a significant statistical difference (alpha = .05) between county Extension agriculturalists with an advanced degree (rarely used) and those with a bachelor's degree (sometimes used) in using instructional posters as a passive teaching method.

There was a significant statistical difference (alpha = .05) between county Extension agriculturalists with a bachelor's degree (sometimes used) and those with an advanced degree (frequently used) in using tape recorders as an instructional tool. County Extension agriculturalists with advanced degrees may have received more training in using a variety of instructional tools.

There was a significant statistical difference (alpha = .05) between county Extension agriculturalists with an advanced degree (rarely/sometimes used) and those with a bachelor's degree (sometimes used) in using newsletters as a passive teaching method. A mass media teaching method like the use of newsletters is highly effective, but the contact between teacher and learner is impersonal (Cole, 1981).
There was a significant statistical difference (alpha = .05) between county Extension agriculturalists with a bachelor's degree and those with an advanced degree in perceived use of the tape recorder as an instructional tool. County Extension agriculturalists with advanced degrees rated it higher in perceived effectiveness.

There was a highly significant statistical difference (alpha = .01) between county Extension agriculturalists with an advanced degree and those with a bachelor's degree in perceived use of the satellite as an instructional tool. County Extension agriculturalists with a bachelor's degree rated it higher in perceived effectiveness.

There were no significant differences found in Part II of the questionnaire (teaching methods and instructional tools used and perceived to be effective) when analysis of variance statistical tests (at the alpha = .05 level) were conducted on years of formal teaching experience.

There were no significant differences found in Part III of the questionnaire (perceptions held regarding the pesticide training program) when analysis of variance statistical tests (at the alpha = .05 level) were conducted on age, years of formal teaching experience, and years of Extension Service employment.

There was a highly significant statistical difference (alpha = .01) between county Extension agriculturalists with an advanced degree (uncertain) and those with a bachelor's degree (agree) in answering the statement, "There is sufficient flexibility for the county Extension professional to modify the pesticide training program". County Extension agriculturalists with advanced degrees may have received more training.
in teaching methods and instructional tools, and may understand better than those with a bachelor's degree the value of using a variety of teaching methods and instructional tools in private pesticide training.

There was a significant statistical difference (alpha = .05) between county Extension agriculturalists with a bachelor's degree (uncertain) and those with an advanced degree (agree) in answering the statement, "Current training of the pesticide trainers is adequate to meet the needs of the program". County Extension agriculturalists with advanced degrees may have more subject matter training and more training in teaching methodology than those with a bachelors degree.

These findings suggested that:

1. County Extension agriculturalists with an advanced degree were in stronger agreement statistically (alpha = .05) than those with a bachelor's degree that in teaching proper pesticide use, environmental concerns, and safety county Extension agriculturalists should possess the relevant and required teaching ability and skills. This finding may reflect more training in subject matter and teaching methodology by county Extension agriculturalists with advanced degrees.

2. County Extension agriculturalists with a bachelor's degree were more in agreement statistically (alpha = .05) than those with an advanced degree that in teaching proper pesticide use, environmental concerns, and safety county Extension agriculturalists should prepare and use self-directed teaching-learning aids. County Extension agriculturalists with
a bachelor's degree may have felt more comfortable using passive teaching methods and instructional tools.

3. Younger county Extension agriculturalists were more likely to use the computer as a teaching tool in private pesticide training than older county Extension agriculturalists. This finding may reflect more subject matter training in computer science and hands-on computer experience by younger county Extension agriculturalists.

4. Younger county Extension agriculturalists indicated a stronger preference than older Extension agriculturalists towards using newsletters as a teaching method in private pesticide training. This finding may have reflected more training in journalism and more training in teaching methodology by younger county Extension agriculturalists. Younger county Extension agriculturalists surveyed may proportionally have more advanced degrees than the older county Extension agriculturalists included in the survey.

5. Newly employed county Extension agriculturalists appeared to be more receptive than longer employed Extension agriculturalists to using the flannel board as an instructional tool in private pesticide training. This may display a lack of bias by younger county Extension agriculturalists towards using this passive instructional tool in private pesticide training.
6. County Extension agriculturalists with an advanced degree were more likely to use role playing and newsletters as teaching methods and the tape recorder as an instructional tool in private pesticide training than those with a bachelor's degree. Again, this finding may reflect more training in teaching methodology by those county Extension agriculturalists with advanced degrees.

7. County Extension agriculturalists with a bachelor's degree were more likely to use instructional posters as a teaching method in private pesticide training than those with an advanced degree. Again, county Extension agriculturalists with a bachelor's degree may have had less training in teaching methodology and may feel more comfortable in using a passive teaching method in private pesticide training.

8. County Extension agriculturalists with an advanced degree rated the tape recorder higher as a perceived instructional tool than those with a bachelor's degree.

9. County Extension agriculturalists with a bachelor's degree rated the satellite higher as a perceived instructional tool than those with an advanced degree. The satellite is considered a passive instructional tool, and those county Extension agriculturalists with a bachelor's degree may have received less training in interactive forms of teaching methodology and instructional tools.
10. County Extension agriculturalists with a bachelor's degree felt more strongly than those with an advanced degree that there was sufficient flexibility to modify the pesticide training program. This may reflect less training by county Extension agriculturalists with a bachelor's degree in interactive forms of teaching methodology.

11. County Extension agriculturalists with an advanced degree felt more than those with a bachelor's degree that current training of pesticide trainers was sufficient to meet program needs. Again, county Extension agriculturalists with advanced degrees may have more subject matter and teaching methodology training, and may feel more comfortable in giving private pesticide training.

In summary, major demographic differences were primarily due to educational level and secondarily due to age and length of Extension Service employment.
CHAPTER VI. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to identify and assess the educational delivery systems used by county Extension agriculturalists in Iowa, Nebraska, North Dakota, and Wisconsin to train private pesticide applicators.

With respect to pesticide applicator training, the objectives of this study were to:

1. Identify demographic characteristics of county agricultural Extension professionals.
2. Identify perceptions held by county agricultural Extension professionals regarding principles of teaching-learning.
3. Identify teaching methods and instructional tools used and perceived to be effective by county agricultural Extension professionals in conducting pesticide training programs.
4. Identify perceptions held by county agricultural Extension professionals regarding the pesticide training program.
5. Compare perceptions and use of instructional methods/tools based on selected demographic data.

Summary

The study was conducted using the descriptive survey method to describe the characteristics of county Extension agriculturalists in 4 states of the 12 state North Central Region, and supply information on
the perceptions of the population sample towards private pesticide training.

A survey questionnaire was developed and used to collect the data. The survey instrument was developed using the experiences of the researcher, his major professor, the literature, and ideas from survey instruments developed by 2 graduates of the Department of Agricultural Education and Studies. The questionnaire was pretested by 10 Iowa county Extension agriculturalists, in an effort to improve the content validity of the survey instrument. Their suggestions improved the readability of the instrument. The survey instrument included the following areas:

1. Appraisal by the respondents regarding perceptions held regarding principles of teaching-learning in pesticide training.
2. Appraisal by the respondents regarding teaching methods and instructional tools currently used and perceived to be effective in pesticide training.
3. Appraisal by the respondents regarding the potential of teaching methods and instructional tools in pesticide training.
4. Appraisal by the respondents regarding perceptions held regarding the pesticide training program.
5. Demographic characteristics of the respondents.

Likert-type scales were used for areas 1 and 4 as follows:
1 = Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, and 5 = Strongly Agree.

For area 2, the following Likert-type scale was used:
1 = Not Used, 2 = Rarely Used, 3 = Sometimes Used, 4 = Frequently Used, and 5 = Heavily Used.

For area 3, the following Likert-type scale was used:
1 = Not Effective, 2 = Of Little Effectiveness, 3 = Somewhat Effective, 4 = Effective, and 5 = Very Effective.

Statistical procedures used to analyze and summarize the data gave percentages, means, standard deviations, t-tests, correlations, and one-way analysis of variance.

Conclusions

The following conclusions were reached after reviewing the findings of this study:

1. The average county Extension agriculturalist surveyed was male, in his forties, had some formal teaching experience, was about mid-career, and had a master's degree.

2. County Extension agriculturalists surveyed did not use a variety of teaching-learning principles in pesticide applicator training.

3. County Extension agriculturalists surveyed did not use a variety of teaching methods and instructional tools in pesticide training program delivery.
4. Statistical differences with respect to program evaluation may reflect the leadership and philosophy of Extension administration.

5. Statistical differences with respect to teaching methods and instructional tools may reflect the extent of training received by participants and the availability of these methods/tools.

6. Statistical differences with respect to perceptions regarding pesticide applicator training may reflect the leadership and organizational policy of state legislatures and state Extension administrators.

Recommendations

This study was designed to identify and assess the educational delivery systems used by county Extension agriculturalists to train private pesticide applicators. Based on this study's findings, conclusions, and the literature review upon which it is based, the following recommendations were made:

1. A variety of teaching methods and instructional tools should be considered, along with subject matter in planning private pesticide training.

2. County Extension agriculturalists should be given the means to modify private pesticide training, to meet clientele needs.

3. Local involvement should be encouraged in planning private pesticide training.
4. In-service training should be given - and formal training made available - to county Extension agriculturalists in instructional methods/teaching tools and in program evaluation.

5. The results of this study should be shared with Extension administrators, legislators, and state and Federal pesticide training coordinators/administrators.

6. An education specialist should be made a part of the state staff/administrative team.

7. Performance review should be based equally on teaching (process) skills and product goals achieved.

Recommendations for Further Research

The following recommendations are made for additional research in identifying and assessing Extension Service educational delivery systems:

1. A more comprehensive survey of educational delivery systems should be conducted of Extension Services within the 12 state North Central Region, and the results compared with the findings of this study.

2. A survey should be conducted to identify what instructional methods and teaching tools training has been provided to county Extension agriculturalists within the 12 state North Central Region.
3. A survey should be conducted to find out what program evaluation training has been provided to county Extension agriculturalists within the 12 state North Central Region.
BIBLIOGRAPHY


Fruhling, L. (1987, March 29). Farmer's toxic chemical training called a farce. Des Moines Register, pp. 1B, 6B.


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Dr. Regis D. Voss, Professor, Department of Agronomy
Dr. David L. Williams, Professor and Head, Department of Agricultural Education and Studies

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APPENDIX

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PART I. Perceptions Held Regarding Principles of Teaching-Learning

Directions:
Please read the statements below and indicate whether you agree or disagree with each by circling the appropriate number. Be sure to carefully read the bold typed opening statement as an introduction to each of the items before giving your answer. Use the following rating scale:

1 = Strongly Disagree
2 = Disagree
3 = Uncertain
4 = Agree
5 = Strongly Agree
PART II. Teaching Methods and Instructional Tools Used and Perceived to be Effective

Directions:

Please indicate in Column A the extent to which you use the listed methods, strategies, and teaching tools in pesticide applicator training. In Column B, indicate the potential level of effectiveness (your viewpoint) of these methods, strategies, and teaching tools in pesticide applicator training, whether or not you actually use them. Use the following rating scales:

<table>
<thead>
<tr>
<th>Column A</th>
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<tr>
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<td>1 = Not Effective</td>
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<td>2 = Rarely Used</td>
<td>2 = Of Little Effectiveness</td>
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<td>3 = Sometimes Used</td>
<td>3 = Somewhat Effective</td>
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<td>4 = Frequently Used</td>
<td>4 = Effective</td>
</tr>
<tr>
<td>5 = Heavily Used</td>
<td>5 = Very Effective</td>
</tr>
</tbody>
</table>
PART IV. Biographical Information

Directions:

Please circle the letter next to the response which best describes your situation. Please circle only one best response or write in the information.

1. Your gender is:
   A. Male  
   B. Female  

2. Your age is (in years):
   A. 19 or under  
   B. 20 to 29  
   C. 30 to 39  
   D. 40 to 49  
   E. 50 to 59  
   F. 60 or over  

3. Years of formal teaching experience (i.e. vocational agriculture, community college, etc), if any:
   A. None  
   B. 1 - 5 years  
   C. 6 - 10 years  
   D. 11 - 15 years  
   E. 16 - 20 years  
   F. 21 - 25 years  
   G. 26 years or more  

4. Years as an employee of the Extension service:
   A. Less than 1 year  
   B. 1 - 5 years  
   C. 6 - 10 years  
   D. 11 - 15 years  
   E. 16 - 20 years  
   F. 21 - 25 years  
   G. 26 years or more
PART IV. (Continued)

5. Highest educational level attained:
   A. Bachelor's degree
   B. Master's degree
   C. Doctorate degree

PART V. Comments

Please give us any comments you have regarding private pesticide applicator training.

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Thank you for taking the time to complete this questionnaire. Please check your responses to see that all items have been completed, then return it in the enclosed envelope. Thanks!
Dear Extension Professional:

Two weeks ago you were sent a questionnaire entitled: "An Identification and Assessment of Educational Delivery Systems for Training of Private Pesticide Applicators". As of this date we have not received your response. Whether or not you intend to complete the questionnaire, we would very much appreciate your returning it in the next week.

We would like to receive your completed questionnaire.

Thank you.

Sincerely,

John L. Creswell
Extension Crop Production Specialist
INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY

(Please follow the accompanying Instructions for completing this form.)

135

1. Title of project (please type): "AN IDENTIFICATION AND ASSESSMENT OF THE EDUCATIONAL DELIVERY SYSTEMS FOR TRAINING OF PRIVATE PESTICIDE APPLICATORS"

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

John L. Creswell
Typed Name of Principal Investigator
7-24-89 Date
Signature of Principal Investigator

Central Ia. Area Extension Office
3005-92nd St., Urbandale, Ia. 50322 (515) 276-3111

Campus Address Campus Telephone

3. Signatures of others (if any) Date Relationship to Principal Investigator
Dr. Robert A. Martin 7-24-89 Major Professor 7-6-89

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

☐ Medical clearance necessary before subjects can participate
☐ Samples (blood, tissue, etc.) from subjects
☐ Administration of substances (foods, drugs, etc.) to subjects
☐ Physical exercise or conditioning for subjects
☐ Deception of subjects
☐ Subjects under 14 years of age and/or ☐ Subjects 14-17 years of age
☐ Subjects in Institutions
☐ Research must be approved by another institution or agency

5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

☐ Signed informed consent will be obtained.
☐ Modified informed consent will be obtained.

Month Day Year

6. Anticipated date on which subjects will be first contacted: 09 15 1989
Anticipated date for last contact with subjects: 10 31 1989

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and/or identifiers will be removed from completed survey instruments:

Month Day Year

8. Signature of Head or Chairperson Date Department or Administrative Unit
Manuel J. Williams 7-6-89 Agricultural Education & Studies

9. Decision of the University Committee on the Use of Human Subjects in Research:

☐ Project Approved ☐ Project not approved ☐ No action required

Name of Committee Chairperson Date Signature of Committee Chairperson