Factors affecting the implementation of an electronic Pest Recommendation Network for pesticide applicators in Montana
by William Thomas Lanier

A thesis plan submitted in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Education
Montana State University

Abstract:
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The objectives of this study were to determine the factors that may enhance or prohibit use of the Pest Recommendation Network (PRN) and how valuable selected pest control topics are to pesticide applicators in Montana Pesticide Applicator Training (PAT) Region 2. The six factors that may have affected a participants use of the WWW were lack of hardware, software, monthly service provider charges, familiarity with what the WWW offers, lack of computer technical assistance or training and/or high telephone line charges. The selected pest control factors were chemical control information, economic thresholds, crop variety susceptibility information, and pest life cycle conditions favoring susceptibility, typical infestation pattern in fields, symptoms and look alike symptoms, cultural control information and knowing required scouting frequency.

The survey group (n = 497) was randomly divided into two groups. Each group received a take-home worksheet that provided step by step instructions on how to access and receive information from the PRN. In addition to the worksheet, one group received training that included verbal explanation of 11 Power Point text slides and 3 PRN screen images from the PRN application. The purpose of the mini-lecture slides were to motivate and familiarize subjects to the availability and value of the PRN. The control group saw only one text slide referring to the PRN. To use the PRN, the control group would have to rely on the worksheet instructions.

In summary, the amount of training the participants received at the Region 2 PAT re-certification program did not significantly affect their access of the PRN. Ranking of the results of the survey showed that people with access to the Internet found familiarity with what the Internet offers, lack of computer technical assistance or training, high telephone line charges as the factors that affected their use of the Internet the most. Participants also ranked chemical control information, economic thresholds, crop variety susceptibility information, pest life cycle as most valuable to their pest control decision making. The results of the demographic section of the survey revealed that over half of the surveyed participants had access to computer hardware, over half used it for farm business and over half had either access to the Internet or email.

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This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the college of Graduate Studies.

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ABSTRACT

The problem is how to deliver pest management information to pesticide applicators, where they live and work, in a manner that does not intimidate them. The delivery structure must allow for the effective use, safety and hazard information to be incorporated into the daily decision-making process.

The objectives of this study were to determine the factors that may enhance or prohibit use of the Pest Recommendation Network (PRN) and how valuable selected pest control topics are to pesticide applicators in Montana Pesticide Applicator Training (PAT) Region 2. The six factors that may have affected a participants use of the WWW were lack of hardware, software, monthly service provider charges, familiarity with what the WWW offers, lack of computer technical assistance or training and/or high telephone line charges. The selected pest control factors were chemical control information, economic thresholds, crop variety susceptibility information, and pest life cycle conditions favoring susceptibility, typical infestation pattern in fields, symptoms and look alike symptoms, cultural control information and knowing required scouting frequency.

The survey group (n = 497) was randomly divided into two groups. Each group received a take-home worksheet that provided step by step instructions on how to access and receive information from the PRN. In addition to the worksheet, one group received training that included verbal explanation of 11 Power Point text slides and 3 PRN screen images from the PRN application. The purpose of the mini-lecture slides were to motivate and familiarize subjects to the availability and value of the PRN. The control group saw only one text slide referring to the PRN. To use the PRN, the control group would have to rely on the worksheet instructions.

In summary, the amount of training the participants received at the Region 2 PAT re-certification program did not significantly affect their access of the PRN. Ranking of the results of the survey showed that people with access to the Internet found familiarity with what the Internet offers, lack of computer technical assistance or training, high telephone line charges as the factors that affected their use of the Internet the most. Participants also ranked chemical control information, economic thresholds, crop variety susceptibility information, pest life cycle as most valuable to their pest control decision making. The results of the demographic section of the survey revealed that over half of the surveyed participants had access to computer hardware, over half used it for farm business and over half had either access to the Internet or email.

CHAPTER 1

THE PROBLEM AND ITS SETTING

Since the beginning of the nationally recognized Pesticide Applicator Training (PAT) program in 1975, rapid changes in pest control practices and public opinion have caused constant refinement of pesticide safety and applicator practices. Gilmore (1994) stated that , "There continues to be increasing attention given to food related issues in our society as the public becomes more aware of the benefits and risks associated with food production, distribution and preservation, preparation, and consumption patterns" (p. 1). Some of this concern is substantiated by facts. "Recent reports from the Food and Drug Administration and Centers for Disease Control indicate that about 33 million people, or 14% of the U.S. population, become ill each year from microorganisms in foods, leading to 9,000 deaths annually" (Barton, 1992, p. 1).

The Environmental Protection Agency (EPA) enforces strict control on pesticide licenses. Farm Worker Protection Standards are strictly enforced, even on family farms. Banks investigate pesticide disposal practices before they accept agricultural land as collateral. On August 3, 1996, President Clinton signed the Food Quality Protection Act (FQPA) into law. This act allowed greater protection for consumers, particularly infants and children by using a comprehensive, integrated approach to risk assessment and risk management using consistent, health based standards. A positive effect of this

perception, from an agricultural point of view, is that the public is very supportive of programs that make their food supply safer.

Montana agriculture has been recognized as a source of abundant safe food and still is, but public perception has changed. Whitford (1993) says negative public opinion is due mostly to how people perceive risk. While farmers are familiar with the costs and benefits of pesticide use, the public, removed from the damage crop pests can cause, is not. The nonagricultural population perceives pesticides as risky because others apply them, are doubtful of the real value and are concerned about unknown or delayed health problems. As a result of scrutiny by the customer, producers of food have responded with scientifically accountable methods of managing pesticide use.

Integrated Pest Management (IPM) is one of these methods. Dr. Sue Blodgett, the IPM coordinator at Montana State University, suggests IPM practices include; 1) applying chemical pest control based on a set of decisions other than pest presence or absence; 2) Scientific thresholds that require knowledge of pest identification and life cycles; 3) Non-chemical or cultural pest control practices that weigh future agronomic considerations with the economic realities of arid crop production; and 4) Chemical control considerations that not only include cost, timeliness and efficacy but also far reaching legal considerations regarding mammalian toxicity, ground water contamination, and pest resistance and used container disposal. This diversity and unprecedented increase in "need to know" information has created a demand for pesticide education information delivery (PAT) to where people live and work.

Thus, as production agriculture in Montana adjusts to meet the demands of a wary public, the need for technically trained employees who are accountable for their actions has increased. National and state governments and land grant colleges like Montana State University (MSU) have responded by formalizing programs, such as PAT, which train people who apply agricultural chemicals. MSU Extension, the information source for PAT, has a database developed through interactions with the MSU Insect, Weed and Disease Diagnostic Labs. The database contains the daily recommendations made by Extension specialists and staff. These recommendations are made for homeowners and producers involved with agriculture in Montana. Recommendations include pest identification and life cycles and non-chemical cultural controls. The recommendations are the results of national research and weigh agronomic considerations regarding arid crop production. The chemical control recommendations entered not only include cost, timeliness, and efficacy, but also are scrutinized for legal considerations regarding mammalian toxicity, groundwater contamination, pest resistance and used container disposal.

Currently, private and commercial PAT sessions use traditional delivery methods during the fall and winter that include demonstrations, slide-illustrated talks, and use of videotapes. In the case of PAT meetings and correspondence courses, three criteria affect the acceptance or use of the PAT program. Acceptance of information delivered by either traditional means or distance delivery technology is, Bauder (personal communication, January 1998) said, affected by three criteria: They are; 1) how much participant comfort is affected by travel, scheduling and personal commitments; 2)

Presentation quality and how the information is formatted and given relevancy to the audiences concerns; and 3) Level of promotion.

While traditional delivery methods provide basic pest information on the major crops to a significant portion of Montana producers, the three criteria and their negative effects on PAT education will increase. Solutions to problems affecting PAT attendance are available.

It has been proposed to deliver an innovative education program to PAT participants. This educational program would provide a novel electronic resource accessible by pesticide applicators when pest information is required and management decisions are being made. In other words, this program would deliver information to where people live and work, increasing their personal comfort. DeYoung, et al. (1995) reported that "a pilot effort (Oregon) revealed ways that networked computers can facilitate communication between diverse audiences and how university extended education can be electronically delivered to participants upon demand" (page 1). To dramatically reduce the costs of delivering this information (incurred by MSU Extension) through traditional means, PAT participants could be provided with improved and individualized information using technology like the World Wide Web (WWW) and methods of distance education. Rossman (2000) defines distance education by saying:

> "Distance education is planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements" (p. 1).

Perfect candidates for distance education are the three politically diverse and geographically separated groups discussed previously: A suspicious public worried about their food supply, agricultural producers who employ scientific practices to produce food and sources of research based information like national and state governments and land grant institutions like MSU.

The WWW and distance education methods could act as the synchronization that correctly meshes the gears moving researched based information from government agencies charged with training to those who produce food for a demanding public.

Experience suggests that as with traditional methods there are criteria that will negatively affect participation in the PRN. Research methods are available to discover the factors which could prohibit or enhance the implementation of the PRN for use by Montana pesticide applicators.

Statement of the Problem

The problem is how to deliver pest management information to Montana pesticide applicators, where they live and work, in a manner that does not intimidate them. The delivery structure must allow for the effective use, safety and hazard information to be incorporated into the daily decision-making process.

Statement of Need

Increasing public pressure and reluctance to fund the traditional Montana educational system suggested that priorities, like remote information delivery, need to be

realigned. These priorities will be the result of public pressure, "No longer passive, members of the nonagricultural public are demanding the farming community, as well as state and federal regulatory agencies, provide greater accountability in identifying and preventing risks associated with pesticide use" (Whitford, 1993, p. 1). Thus, the PAT program is charged with providing pesticide use, hazards, safety, and pest management information to new licensees and re-certification applicants.

Strong participation in an effective PAT educational system is vital to successful delivery and implementation by the user community and acceptance of the food supply by the public. As providers of information to the PAT program, MSU Extension agents and specialists are being called on to provide information about safe and effective management techniques. These recommendations require information about pest identification and life cycles, non-chemical, cultural control methods and they weigh future agronomic considerations regarding the economic realities of arid crop production. Chemical control recommendations need to include cost, timeliness, and efficacy of control, but also legal considerations regarding mammalian toxicity, groundwater contamination, pest resistance and used container disposal. Pesticide education programs supplied with information by MSU Extension specialists and staff are unique in providing a research-based source of pesticide information and application practices for various pest management situations.

An important part of the information gathered by Extension specialists and staff is done by the MSU insect, weeds and disease diagnostic labs. A software application, the Pest Diagnostic Database (PDD), has been developed to log submitted samples,

incorporate recommendations, and report making. The database contains over five years of insect and disease occurrences. The database provides recommendations, which are continually updated as new information is developed and are dynamic and historically accurate with respect to problem severity, crop stage, location in state and time of year. Presently staff delivers information to remote users including pesticide applicators via phone, mail and computer modem using the MSU Outreach Network. Written sources (books, Extension fact sheets) are often not updated annually, tend to be more generic. They do not include localized or very recent information. Recommendations for pest management are more likely to be updated, especially for local situations, but may not include detailed information about pest monitoring, life cycle and non-chemical management strategies. In other words, current information exists; a structure for delivery does not.

In an effort to solve the problem of delivery, the PDD has been incorporated into a networking software program, the Pest Recommendation Network (PRN). The PRN has been deployed on the web at http://Scarab.msu.montana.edu/PRN1, since March 1998 and allows remote users access via Web browsers. Users can access PDD information and apply it to their situation by a method of data organization called Case-based Reasoning. Recommendations in a cased-based format can also be linked or integrated across subject areas. The resulting recommendations are integrated based among subject areas accessed. Users of the database are presented with a ranking of situations or solutions similar to theirs. The user obtains a list of possible management options, implications for potential pesticide hazards, safety aspects and environmental

concerns. The PRN integrates pest management expertise of Extension agents, consultants, and specialists with pest information and seasonal occurrence from the Insect and Disease Diagnostic Lab database.

Users of the PRN are presented with a ranking of Pest situations or solutions similar to theirs. The resulting PRN compliments pesticide education by providing an extensive database of localized or regionalist pest occurrence information, incorporating information about safety and appropriate pesticide use, and improves the ability of the manager to incorporate safety issues into decision-making.

The gears, a suspicious public worried about their food supply, Agricultural producers who employ scientific practices to produce food and National and State governments and Land Grant institutions are in place. What is needed is knowledge about factors allowing or prohibiting these gears from meshing.

Objectives

The goal of Pesticide Applicator Training (PAT) is to deliver research based information about pest control to participants who produce a nutritious food supply. This study was conducted to evaluate the factors affecting the implementation of an electronic pest recommendation network (PRN) for PAT in Montana. The findings reported in this paper were determined using a pre-survey, training, control and post-survey of a portion of the population. Participants in the study were pesticide applicators (n = 497) in Montana PAT Region 2 (Choteau, Teton, Cascade, Toole and Pondera) counties.

Participants were randomly assigned to one or two groups: trained or control. The intent of this study was to determine the following:

(1) If Pesticide Applicator training (PAT) influences a participants level of PRN use;

(2) If lack of hardware, software, monthly service provider charges, familiarity with what the WWW offers, lack of computer technical assistance or training and/or high telephone line charges influence if a participant uses the PRN; and

(3) If the relative value of the following topics were a factor in PRN use:

   (a) Crop variety susceptibility information

   (b) Conditions favoring susceptibility

   (c) Symptoms and look alike symptoms

   (d) Economic thresholds

   (e) Pest life cycle

   (f) Knowing required scouting frequency

   (g) Typical infestation pattern in fields

   (h) Cultural control information

   (i) Chemical control information

Assumptions

The assumptions for this study were:

(1) Producers want useful pesticide application and hazard information.

(2) Useful pesticide application and hazard information exists to distribute to Montana producers.

(3) A time lag exists between when the pesticide information is published in a useful format and when it reaches the producer in a useful format.

(4) Pesticide applicators who answer questions regarding the usefulness of recommendation previously supplied via the PRN then they are incorporating information into the daily decision making process.

(5) Pesticide applicator who owned computer hardware also knew how to use it.

(6) The factors affecting the use of Distance Education technology by college students would also affect PRN use by growers.

(7) Producers did not know that the PRN exists.

Limitations

The population for the study was limited to 1757 Montana residents who participated in Pesticide certification and re-certification programs in PAT Region 2 (Choteau, Teton, Cascade, Toole and Pondera counties). This group of producers was meant to serve as a sample, and considering limits to external and internal validity, allow inferences to other PAT regions. The collection of data was to be completed within two PAT training seasons.

Definition of Terms

The following definitions are for terms contained in this study:

Distance Education (DE) The separation of teacher and learner during at least a majority of the instructional process. The influence of an educational organization, including the provision of student evaluation. The use of educational media to unite teacher and learner and carry course content. The provision of two-way

communication between teacher, tutor, or educational agency and learner (Verduin and Clark 1991, p. 11)

Pesticide Recommendation Network (PRN) Computer software that allows the user to access the Pest Diagnostic Database of recommendations in a Case-based Reasoning format and use the information in pest management decision making.

Pesticide Applicator Training (PAT) Statewide delivery of National Pesticide use and safety information.

Case-based Reasoning (CBR) A method of reasoning that solves new problems by adapting solutions that were used to solve old problems.

CHAPTER 2

REVIEW OF LITERATURE

This literature review focuses on the adoption of computer technology, adult and distance education applicable to the Montana Pesticide Applicator Training (PAT). A definition, brief history, and underlying principles (types, delivery, evaluation) of each are included.

Androgogy and PAT

Androgogy is the mechanism of adult learning, the conditions for effecting a permanent change in an adults behavior (Zemke and Zemke, 1981). When conditions warrant (career changes, birth, marriage, retirement etc) adults seek out and demand learning experiences. Ideally, androgogy is the facilitation of this experience. Adult educators encourage an adults' natural motivation to learn. This is especially true when the adult believes they need to learn. Educating adults who are not instinctively motivated to learn requires outside motivation and incentives. So confronted with the impossibility of ordering adults into a classroom, prodding them into seats and forcing them to learn, USDA funded educators, especially those dealing with restricted use agricultural chemicals employ an economic incentive. The incentive is "Learn to apply pesticides (an important component of agricultural profit) according to the label or they

will not be available for purchase" (Reeves Petroff, personal communication, Great Falls, January 2000).

In addition to the lack of motivation, problems with presentation quality and the perceived relevance of complex scientific information can also confound ideal androgogy during PAT sessions. Lacefield (1998) suggests a lecture may be the best way to teach an inexperienced, fresh-behind-the-ears, recent high school graduate and it may also be the best way to teach an older adult with limited self-directed learning experience. The PAT audience is a cross section of the agricultural population and it includes "adults in the first stage of intellectual and ethical development (a group which is not restricted to the young) see the world in polar terms of right vs. wrong" (Lacefield, 1998, p. 3). If the presentation does not portray information in "do this" or "do that" terms it may cause intimidation. Dr. Lacefield (1998) goes on to add that "These students have little tolerance for gray areas. When faced with uncertainty in a course, these learners will often perceive the instructor as poorly qualified and this lack of qualification as the reason for the uncertainty" (p. 3).

Petroff, the PAT coordinator for Montana, observed that two out of 30 PAT participants might be motivated to learn, the rest are there to receive credit so they can purchase chemical pesticides necessary for agricultural production and the lack of motivation to learn and apply PAT information professionally results in poorly calibrated spraying equipment (Reeves Petroff, personal communication, Great Falls, January 2000). Based on continuing problems occurring with pesticide application the portion of the audience that makes right or wrong decisions may be large. Weaver, a MSU stored

grain specialist, agrees and noted the number of instances of misapplied stored grain fumigants that occur every year (David Weaver, personal communication, Bozeman, May 2001). Jones (2001) a MSU soil scientist, reports in the Montana Crop Health Report that the active ingredient in the herbicide Assert has been detected in groundwater under the agriculturally productive Fairfield bench. In extreme cases Petroff (2001) suggested that even deaths occur when chemicals are applied incorrectly.

USDA funded PAT is not the only program employing incentives to motivate agricultural producers. In Denmark, agricultural units collect detailed data from grower's clubs. The economic incentives (bulk discounts) to be a member of a growing club are large. The data collected from the growers clubs are published in a report. This report allows comparison of the amount of fuel, pesticides and fertilizers used to grow a unit of production. Each member knows their own identification number, but not the identification numbers of the other members. With this type of information exchange it is easy for a club member to compare the effectiveness of different operations, gauge trends across the membership and adjust their practices. On the other hand, it is easy for the administrator to do the same and initiate trends and suggest best management practices.

Even though, ideal androgogy may not be completely effective at educating a PAT audience motivated by an economic incentive, androgogical literature does offer guidelines to discuss factors affecting the implementation of information, like PAT, by adults. The purpose of this study was to identify what factors could augment or impede the incorporation of effective use, safety and hazard information via the delivery

structure of the PRN, a decision support system. Following are some of the important androgogical factors applicable to PAT.

Adult Memory in Androgogy

Is adult memory a factor that should be addressed when educating the PAT audience? Merriam et al. (1991) stated, "That adult intelligence appears relatively stable, at least until the sixth or seventh decade" (p. 158). It seems that adults can remember and that a more important consideration is how the information to be remembered is structured. Lacefield (1998) says that "accommodating changes occurring in adult memory and experiences requires consideration, especially when adults are faced with meaningless learning, learning that involves reassessment of old knowledge, and pure memorization" (p. 1). Dixon (1994) said that "the more ways a meaningful structure is connected to our existing knowledge, the more likely we will be able to retrieve it" (p. 16). Literature addressing the implications of adult memory frequently include terms suggesting that information structured in away that connects or relates the information to previous knowledge and experience will be most successful.

Course Design and Androgogy

After memory considerations Knowles (1980) believed, that a second factor is designing courses that include information that allows the adult to apply their experiences to problems rather than subjects and these problems should reflect the concerns that adults have experienced or foresaw. So in order to design the course

around the concerns of the student it is important to identify the motivation of the adult student. In other words, if adults want information to help them find a new job, an effective course design would include problems requiring job hunting tactics and strategies. Often, individual learners each have a myriad of reasons for attending courses which makes identification of concerns more difficult. Lacefield (1998) suggested that a learner may be motivated by the following:

1. Intention of using the knowledge or skill for a particular job or completion of a particular task;
2. Imparting the knowledge and skill in order to teach or share it with others who plan to use the skill;
3. Future understanding or learning in order to understand something which has not yet occurred;
4. Pleasure and self-esteem from possession of a skill or knowledge.
5. Learning for credit and not because the skill is important to the learner (p. 3).

Another attempt to define types of motivation categorization by Houle (Merriam, 1991 et al.) separates the motivations of learners into three types generalized to encompass the diversity. These are:

1. Goal-oriented learners who use education as a means to an ends;
2. Activity-oriented learners who participate for the sake of the social interaction;
3. Learning-oriented learners who seek knowledge for knowledge's sake (p. 83).

Knowing the motivation of the participants will allow their concerns to be identified. Addressing these concerns leads to effective course design and content. If motivation and level of concern of the participants are lacking what can be done?

Course Structure and Androgogy

Historically PAT programs bring training to community centers. The training structure uses lecture as the important activity. While this is a practical activity, there are problems, when lecturing to adults, especially adults whose motivation and concerns do not lend itself to learning. Brookfield (1992) has found;

> "that these learners often complain that facilitators are abdicating their role by forcing learners to take responsibility and make judgments they are not equipped to make. Instead of being pleased about opportunities to form their own opinions and judgments, they may be confused and intimidated by this reversal of their expectations about education" (p. 13).

Experience has identified that a level of motivation below what is required by the course or lecture increases participant intimidation. Motivation and the concerns of the participants is a factor in the acceptance of PAT information. Concerns about pesticides are low and participants only have a certain amount of time and energy to expend learning about pesticides before they see the effort as impractical. Much of this motivation is expended traveling to the session. So changing the structure (less intimidating) and delivery (less travel) the motivation required to participate in the course could be applied, more effectively, to learning PAT.

A typical PAT lecture attempts to address the motivation levels of all participants at once. Thus a participant who is more motivated to learn is forced to attend for the same period as a participant who is less motivated, increasing the chances that at some time the effort expended will be perceived as impractical by some of the participants.

Following is a discussion of what type of computer systems might be structured to deliver PAT information to a audience with diverse levels of motivation. However, before investigating how to structure a course addressing multiple levels, the problems of delivery to users who are removed from the teacher in time and space should be discussed. This literature review will now present information about Distance Education and PAT.

Distance Education Defined

The advent of technology brought attention to the possibility of education in situations where the teacher and student are at a distance. It is interesting and informative to see how the definition evolved from the inception to the present. The first attempt in English to define distance education and to articulate a theory appeared in 1972 and in 1980 was named by Moore as the theory of transactional distance. In a reflective editorial Moore (1991) said,

> "It is a distance of understandings and perceptions, caused in part by the geographic distance, that has to be overcome by teachers, learners and educational organizations if effective, deliberate, planned learning is to occur (p. 1).

Another version of this definition made by Verduin and Clark in 1986 acknowledged the use of computers and audio video equipment to unite teacher and learner. It also suggested that two way communication distinguishes distance education from other uses of technology in education. Finally, this version placed emphasis on the separation of teacher and learner during at least a majority of the instructional process.

Almost 14 years later, Rossman (2000) further defined distance education as follows:

> "Distance education is planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements" (p. 1).

Distance Education History

Organized mail delivery in Britain allowed the first distance education efforts, and Verduin and Clark (1991) believe that, "The History of education at a distance may have started with a course in shorthand. Isaac Pitman used the British Penny post system to receive Bible passages his students had copied in shorthand. This course was the first to include formal grading" (p. 15).

This type of correspondence course has dominated the distance education scene from 1880's to present and most distance education in this form occurs through organizations other than colleges or universities. The Distance Education and Training Council (DETC), formerly the National Home Study Council, estimates that today more than 2.5 million Americans are enrolled in DETC-accredited institutions (DETC, 2001). It is estimated that since 1890, some 130 million Americans have taken distance study/correspondence courses. Other applications are emerging and prospering, especially in colleges and universities.

Distance Education Types

Paulsen (1995) categorizes Distance Education types into predominant communication paradigms: (1.) One-alone: Online Resources Paradigm which is a model in which the student is a self-directed learner, often only interacting with online resources like online databases, journals, interest groups, and interviews. These activities will tend to be heavily structured but they require minimal interactivity, on the part of the instructor; (2.) One-to-One: the Email Paradigm: Email instructional methods are characterized by individual and individualized instruction and learning. Often these techniques (learning contracts, apprenticeships, correspondence studies) rely heavily on the personal relationship between the student and the teacher; (3.) One-to-Many: the Bulletin Board Paradigm a model in which the students are exposed to one or more experts in a given subject area. Usually these methods (lectures, symposia, skits) imply passivity on the part of the learner; (4.) Many-to-Many techniques: the Conferencing Paradigm is a technique "that all participants have the opportunity to take part in the interaction (discussion groups, debates, simulations, case studies, role plays, brainstorming, group projects).

However, it is important to realize that new technology may for the short term seem like new methods of distance education. Often the new methods are merely media developments and "Although the introduction of a new media system usually brings with it a novelty effect...media are mere vehicles that deliver instruction but do not influence

student achievement any more than the truck that delivers our groceries causes changes in nutrition" (Verduin and Clark, 1991, p. 11).

The introduction of new technology will continue. Currently, the best example is the World Wide Web (WWW). On one hand, novelty is high and content is lacking in many of the home pages. On the other, it has taken the Library of Congress over a hundred years to collect 14 million books and catalogue them. The WWW collected ten million documents, cataloged them and made them available without respect to physical location in less than five years.

Distance Education and PAT in Montana

Previous to the discussion of distance education, was a discussion of how low levels of motivation and concern increase the possibility of intimidation and cause the information to be deemed impractical. A PAT participants motivation is low and so are their concerns, making it hard to develop effective programs. Currently a PAT participant's motivation must equal or exceed the effort, outlined below, required for re-certification. To become certified an applicator has two options:

> 1) Attend an approved 6 hour initial pesticide training program AND complete an Initial Quiz at the end of the session. The PAT coordinator should go over the quiz with individuals that answered less than 70% of the questions correctly. OR 2) Complete an open book Private Applicators Certification Exam (Exams 1 or 2) and answer at least 70% of the questions correctly. Note that Initial Quizzes are different from Certifying Exams!
> Once an individual has received their private pesticide license they are termed as re-certifying applicators. In order to be eligible to renew their farm licenses for another 5 year cycle, re-certifying applicators must either:

> Accrue 6 pesticide re-certification credits (points) over the course of the 5 year re-certification cycle for their district; OR Take a closed book Exam (Exam 3) during the re-certification year (5th year) and answer 70% of the questions correctly. The accrual of the 6 points does not need to take place all in the re-certification year, but can be spread out over the 5 year period (Montana Pesticide Education Program, 2001 p. 1).

Early in 1998 online quizzes were made available in an attempt to match course structure to the motivational level of a Montanan seeking to accrue pesticide re-certification credits. By completing a Web quiz either in the home or County Extension office a participant can decrease the price of attending a presentation. It is unknown if the quizzes reduce intimidation or increase the acceptance of PAT information. It is known that the quizzes are becoming more popular. The quizzes were made available late in 1998. From August 1998 – January 2000, two quizzes were completed. From 2000 – 2001, 38 quizzes were completed by Montana PAT participants.

Would PAT participation become more effective if the PRN could be used to deliver complete PAT training required for certification requirements? The Case-based reasoning structure of the PRN matches user input (describing past experiences) to database information and develops a checklist of possible solutions. Unlike a lecture, user input or motivation to find an answer drives the Case-based reasoning to a solution. The PRN can be delivered to the users workplace or home and so what motivation is available is applied to getting an answer and not to, for example, travel. To learn more about factors affecting the acceptance of software like the PRN the following literature was reviewed.

Factors affecting Adoption of Computer Software or Decision Support Systems in Agriculture

PAT structure that does not intimidate and can be delivered to the participant for completion, at their discretion, of PAT certification should consider the following. As Lacefield (1998) and others suggest, that while we want to move our students toward independence and ability to direct their learning, we must be aware that not all will embrace the opportunity. In the early stages of this process, many will struggle, complain, and be very uncomfortable. Facilitation should be balanced with structure. We should aim to be a guide on the side but we may want to avoid requiring students to blaze their own trails.

If structure appropriate to a PAT participants concerns would help those confused and intimidated with the gray areas of complex scientific practices, might computer software deliver such structure? Could intimidation be reduced and participant motivation applied more effectively using software delivered on the WWW? Many Land Grant Universities believe this to be a possibility and are developing a type of computer software named Decision Support software. Literature delving into the "why" of computer adoption and decision support software is considered next.

In a recent study of the adoption of computers and the software that runs on them, producer age and innovative behavior was studied. It is believed that younger producers adopt computers to make up for lack of experience. Ascough, et al. (1999), found that: "non-adoption of computers among farmers can be explained as a rational decision. It appears that computers are being adopted more frequently by less experienced producers

to compensate for lack of experience" (p. 203).

Another factor affecting adoption of computer technology is innovative behavior. Five categories describe innovative behavior. They are adopters; innovators; early adopters; early majority; late majority; and laggards. Lewis (1998) says, "Adopter category groups tend to be normally distributed and on average there are: 2.5% innovators; 1.3% early adopters; 34% early majority; 34% late majority; and 16% laggards" (p. 234).

In summary, the literature review above suggests computing will be adopted by younger producers at a rate determined by their adopter category and that the average audience includes persons from each category. As this literature review progresses it seems to be increasingly apparent that addressing a diverse audience could improve effectiveness of PAT.

Decision Support Systems

If structured PAT computer software addressing varied levels of motivation and innovative behavior could improve implementation of PAT, what kind of software tool would work? Decision support systems are models developed to improve the decision-making process or in other words decrease the grey area of decision making inherent in complex scientific information. First, a discussion of the basic idea behind decision support systems or models. Attonaty et al. (1999) believes that, models are considered as "only a means to an end, which is to have a well structured and coherent debate about a problematical situation in order to decide how to improve it'' (p. 42). He adds that

"Deliberate strategies" combine with "emergent strategies" to produce "realized strategies." Deliberate strategy refers to a project formulated in a stable, foreseeable or controllable environment. Emergent strategy refers to a strategy learned from action experience. Attonaty et al. (1999) stresses that trials and failures, experiments and apprenticeship are part of the process.

Several successful efforts have been detailed that have utilized Case-based reasoning, an artificial intelligence approach, to problem solving. Schank and Leake (1998), from the Artificial Intelligence Project, Yale University, said that:

> "When people encounter new situations, they often explain them by remembering old explanations, and adapting them to fit. We believe that this case-based approach to explanation holds promise for use in AI systems, both for routine explanation and to creatively explain situations quite unlike what the system has encountered before" (p. 1).

Decision support systems using Case-based reasoning projects, other than the MSU PRN, have been developed by Land Grant Universities. At Virginia Tech University, CFACTOR (A Case-based Reasoning Approach to Evaluating Crop Rotations) is a program to evaluate crop rotations for the risks associated with soil erosion and pesticide pollution in a farming system. The applicability of a case-based reasoning approach has been developed to solve agronomic and entomological problems including erosion and pesticide-free pest management. Indiscriminate land use promotes erosion that leads to severe problems in the future. Crop rotation is one of the several approaches to contain erosion losses and offers mitigation of some crop pests. Some crop rotations may result in negative impacts on the environment. The pesticide pollution risk of a crop rotation is evaluated based on suitability of the rotation as a pest

management practice and on evaluating criteria like possible pest outbreaks in a rotation, the available control options and the environmental risks associated with these control options (Virginia Tech University, 2001).

A University of Wyoming project, CARMA, produces advice about the most economical responses to Wyoming grasshopper infestations. CARMA does this by predicting the proportion of available forage that will be consumed by grasshoppers and estimating the economic returns of various treatment options. The information required to make the forage loss prediction includes the date, the infestation location on a Wyoming map, the range value and infestation history of the location, the number of grasshoppers per square yard, the grasshopper type and age distribution, the relative recent precipitation and temperatures, and the total area infested, including adjacent neighbors' lands (Hastings, 1996).

Possible Methods for Increasing Adoption of Computers by Montana Producers

Research into adoption suggests that maybe PAT is not accessing potential partners in the adoption process. Attonaty, Chatelin and Garcia, (1999) looked at adoption of computers by producers early in there use for farm management and found that consultants who had knowledge of computers played an important role in guiding the producer, who had knowledge of farming goals to useful solutions.

How decision support software delivered over distance could act as a means to amplify interaction is expressed by Attonaty et. al. (1999).

> "The farmers reconsidered the use of the optimization tool in various ways not predicable at the beginning. They agreed on the process of building generic patterns as a means to increase their intelligence of possible solutions. To design their own solution, they adopted an iterative and incremental attitude to attain a satisfying solution and they use the optimization tool as a what-if calculator. In fact, despite the lack of interactivity in computer terms, the tool proved it interactive in that it encouraged the different people involved in the process to make a dialogue, to ask questions, and to re-assess their ideas" (p. 159).

Interaction about specific problems using selected variables agreed upon by those involved is probably the most valuable aspect of decision support or modeling projects. Decision support systems like the PRN rarely supply the exact right answer, what they do is to allow the concerned user to address what is important, discard what is not and arrive at a well informed decision. In addition, allowing low risk "what if" opportunities to participants during and after the formal discussion allows those requiring clarification or interested in other facets of the problem to return or delve deeper into the problem and solution to their satisfaction creates an valuable learning tool. The model coordinates opinions, experience and expertise for problem solving. Applying this process to the PAT problem, would accommodate different levels of participant motivation and concern.

Changing Agriculture and Changing Extension

The term agriculture suggests research, engineering, banking and education, it no longer means just farming. Information about agriculture is becoming more and more important. Concerns about agriculture and its impact on society are driving public perceptions and competition for resources.

The Smith-Lever Act, 1914, act helped define the beginning of federal efforts in agricultural education. Since this beginning change and innovation has been a inevitable burden. The alarm for change and innovation has often been delivered by a reduction or lack of increase in public funding and is causing Extension systems in many states to consider program restructuring. Extension administrators and personnel are examining program content to ensure that critical needs are being met.

Besides changes, discussed previously, in consumer perception of agriculture, life in agricultural communities is being reassessed by those living it. A child and family development specialist, DeBord (1991) says that,

> "Family farms, typically associated with rural areas, no longer support immediate or extended family members. Farms are being sold, women are taking more lucrative positions, and community service agencies are realizing the need to change traditional programming methods to meet the needs of traditional rural clientele" (p. 1).

Changes in how those in agriculture value their quality of life will affect the motivation to continue living with agriculture and the practicality of PAT.

Agriculture and Pesticides

Pesticides are very important to production agriculture and a study cited in a Hudson Institute paper by Avery (1996) suggests just how important:

> "yield in crops would drop between 24 percent and 57 percent without pesticides. Wheat yields would be harmed the least, at 24 percent, and corn yields would be cut by 32 percent and rice by 57 percent. One study on fruit and vegetable production concluded that yields would drop from between 50 percent and nearly 100 percent depending on the crop and location. Another study concluded that fruit and vegetables consumption

> would decrease by 11 percent because of high prices and that acreage required for production would increase by 44 percent" (p. 10).

The value of pesticides to agriculture can be discovered, as many a gardener knows, with very little first hand experience.

Extension Pesticide Applicator Training: History and Mission

The safe use of pesticides has been a major focus of Cooperative Extension Service (CES) programs since 1960. Concerns about pesticide use and effects on the environment prompted Extension to formalize its educational programs on pesticides, based on this need, and the concern for the health of those who use pesticides, including homeowners and commercial applicators, as well as farmers and ranchers.

The Pesticide Applicator Training (PAT) program was begun in the mid 1970's, in order to train applicators in the safe use of restricted use pesticides. On an annual basis, Extension trains over 500,000 pesticide applicators (USDA, 1995). CES also provides pesticide education to a diverse audience, ranging from rural to urban settings. In 1994, "CES reported making almost 4 million contacts via training programs, educational displays, news articles, radio and TV and one-on-one communication" (USDA, 1995, p. 1). Topics such as homeowner use, proper storage and disposal, ground and surface water concerns, endangered species, worker protection, food safety, integrated pest management and risk/use reduction are covered.

The Pesticide Applicator Training program provides educational opportunities and information to people who use pesticides as part of their livelihood, to consumers

with questions about the use and impact of pesticides in their everyday lives, to students at Montana State University and at other institutions, and to decision-makers such as local, state and federal government regulators and legislators.

> Our mission is to improve pesticide use practices to protect humans and the environment by providing information on IPM concepts, pesticide use data, laws and regulations, and environmental stewardship leading to a sound understanding of pesticides and their responsible use.
> The philosophy is that PAT is in the business of pesticide education to teach people to:
>
> (a) evaluate when pesticides are needed
> (b) apply pesticides safely
> (c) understand the impact of pesticide use
> (d) know and understand the impact of pesticide-related laws and regulations" (Montana PAT Program, 2001, p. 1).

Pesticide applicators have improved their knowledge and attitudes about materials. In 1994, there were 292,613 private applicators in training programs designed for certification as users of restricted use pesticides. This represented an increase of over 20,000 applicators over 1993. There were also 215,885 commercial applicators that were trained during 1994, an increase of several thousands since 1993. Almost 4 million individuals took part in educational programs on pesticide safety. There were 206,755 pesticide applicator trainees who adopted improved pesticide use practices as a result of PAT in 1994 (USDA, 1995).

Major PAT Accomplishments and Highlights

It is hard to quantify the contribution of PAT to the quality of the food supply, it is easier to judge the programs contribution based on the results of scientific research. If we use risk as a guideline, food scientists rate the risk to our health from pesticide

residues less than the risks associated with microbial contamination, nutritional imbalance, environmental contaminants and naturally occurring toxicants. Many other activities are considered riskier than consuming food.

CHAPTER 3

METHODOLOGY

This section describes the procedures used in completing this study. Included is a description of the design and rational of the study, population, how the population was sampled, a description of the study instruments, and the methods by which data were collected and analyzed.

Rationale for Research Design

The design for this study was a pre-survey of the entire sample and post survey of the portion of the sample who accessed the Pest Recommendation Network (PRN). Included in the design was an opportunity to explore the effect that training had on Montana pesticide applicators use and application of the WWW resources.

Design of the Study

The objectives of this study were to determine the factors that may enhance or prohibit use of the PRN by pesticide applicators. To this end, the design for this study used a pre-survey (S), training (RT), control (RControl) groups determined at random and post survey of those trained participants who accessed the PRN (PRN S).

S RTrain PRN S
RControl

In addition to the "Survey of Pesticide Applicators accessing the Web" (S and PRN S), both trained (RT) and control (RControl) groups received the take-home worksheet (Appendix C) that provided step by step instructions on how to access and receive information from the PRN. In addition to the worksheet, training (RTrain) included verbal explanation of 11 Power Point text slides and 3 PRN software screen images, screen #1, screen #2 and results screen from the PRN application (Appendix D). The purpose of the mini-lecture and slides were to motivate and familiarize subjects to the use of the PRN. The control (RControl) saw only one text slide (Appendix E) referring to the PRN. To use the PRN the control group had to rely on the worksheet instructions.

The major dependent variable of this study was the number of each group (RTrain or RControl) that would access the PRN in the future. The moderator variables were applicator type (Private, Commercial, Restricted), Career type (Producer, Certified Crop Advisor, County Agent, Agricultural business), lack of hardware, software and/or high telephone line charges, service provider charges, lack of computer technical assistance or training, and familiarity with what the WWW offers. The perceived value by the PRN user of: crop variety susceptibility information, conditions favoring susceptibility, symptoms and look alike symptoms, economic thresholds, pest life cycle, knowing required scouting frequency, typical infestation pattern in fields, cultural control information, chemical control information. The independent variable was amount of PRN training received.

Threats to Internal Validity

Gall et al. (1996) discuss eight threats to the internal validity of designs with control groups that were identified by Stanley and Campell in 1963. These threats are: history, maturation, testing, instrumentation, regression, selection, mortality and interaction effects.

Over time activities unrelated to the experiment may affect the performance of the dependant variable. These activities are regarded as history. The public is experiencing a rapid increase in awareness of the WWW and this could have affected the results of this survey. A control group was used to help gauge the effects of history and aid in the identification of the reason survey participants accessed the PRN.

Threat of maturation refers to changes, mental or physical that occur over time to the subjects. So, if the duration of the study occurs over a long period of time as this survey did (greater than 1 year but less than 2 years) other reasons and factors could affect the use of the PRN other than the amount of training received by each group. A control group and randomization should have controlled this threat to internal validity.

Internal validity is also threatened by surveying. Often the survey itself forces the subjects to organize their thoughts or perceptions and epiphanies may occur. This mental and emotional development may cause the subject to enter different answers on the post survey. The reason for the different answers may not be related to the training. The topics on the survey were only slightly related to the PRN subject matter and a control group, like the untrained group, has proven a good method to account for the threat of

testing.

All data were entered and sorted using MS Access and Excel software. The SPSS Base 10 statistical package was used to analyze the data. Reliability of the instrument was determined to be significant at the Alpha = .9040 (Section 1) and Alpha = .8837 (Section 2) level using the Cronbach's Alpha statistical method. This reliability test measures a lower bound indicating the true reliability of the survey. It measures the amount of variability that is a result of the participants opinions rather than a confusing survey design.

Statistical regression occurs whenever a test-retest procedure is used to assess change as an effect of the experimental treatment, there is the possibility that statistical regression accounts for observed gains in learning (Gall et al., 1996). The design of this survey did not include testing, which reduces the possibility that this threat affected the dependant variable. Survey results from both groups were compared using a Mann-Whitney, Wilcoxon and Freidman (for Likert-type scale questions) comparison tests useful for non-randomized populations. No statistical difference was evident between the control or trained group so it is unlikely that statistical regression affected internal validity.

Differential selection of subjects usually occurs when already formed groups are used. Thus, the groups may be different before the study began. The survey was administered on two different days to people who needed credits to meet the 5 year cycle certification requirements. There were no indications of any factor(s) like poor weather or other meetings that might have prevented a representative portion of the population

from attending either session. Survey results from both groups were compared using a Mann-Whitney and Wilcoxon, and Freidman (for Likert scale questions) comparison tests useful for nonrandomized populations. No statistical difference was evident between the two session days so it is unlikely that statistical regression would affect generalization to the Region 2 PAT population.

Mortality or attrition refers to subjects who drop out of a study due to illness, or resentment that the treatment is demanding or threatening. Those subjects who drop out of a study may possess characteristics such that their absence has a significant effect on the results. If this attrition was not similar across treatments it might have inflated the percentage of people accessing the PRN.

The last threat to internal validity is selection-maturation interaction. This broad category refers to the situation where one group, possibly the group receiving the training, is more mature in a given area than another group. If for some reason a more mature group attended a session on one day than the other this could have affected the dependant variable.

Threats to Population Validity

Population validity concerns the extent to which the results of an experiment can be generalized from the sample that was studied to a specified, larger group. Gall et al. (1996) discuss threats distinguished by Bracht and Glass in 1968 to population validity. The threats to population validity that are applicable to this study are: selection-treatment interaction, specificity of variables, experimental effects, and reactive arrangements.

Selection-treatment interaction occurs when subjects are not randomly selected, reducing the ability of the results to accurately predict characteristics of the population. Randomization was not used to select the subjects for this survey, so the survey has good internal validity, and could be generalized to the Region 2 PAT population. On the other hand generalizations made to the entire Montana PAT population would be weak. The nonparametric statistical tests, Mann-Whitney and Freidman, were used since they do not assume that the population is normally distributed (SPSS, 1999).

Specificity of the variables or when the post survey is administered also threatens the population validity of the results. The major factor that could have threatened the results was the threat of time measurement and treatment effect. It was the PAT participants decision to take the post session survey and this decision could have been made as much as a year past the survey date. In addition, during the growing season priorities may change and information valuable at one time may not be valuable at another. The particular period in the growing season might allow the subject to assess the PRN, a new source of information, when during another it may not be feasible and the participant may access historical sources of pest information.

Experimental effects could have affected the response of the subjects and resulted in less external validity. Any passive elements (age, race, anxiety), active bias, and evaluation bias that the researcher exhibited during the research process could have affected the subjects responses. These experimental effects could have affected the number of the subjects that accessed the PRN since the researcher developing the PRN was also the lecturer.

An important threat to external validity are reactive arrangements. This threat refers to a number of factors associated with the way a study is conducted and the feelings and attitudes of the subjects involved. In other words the Hawthorne effect may have affected results of the survey. Neither the trained group or the control group knew they were receiving a different lecture so the Hawthorne effect would not have affected the number of participants who accessed the PRN. On the other hand, mandated Government training like PAT is very often perceived as a chore or unnecessary infringement on the subjects life. So a participant, who might have been interested if information about the PRN had been delivered by the "Paul Harvey" radio message, or "early adopter neighbor" may have paid less attention because of the mandate. It is possible that the participants may also have been affected by a lecture suggesting they would have to make decisions using technology. Learners without a recent history of education often complain that facilitators are abdicating their role by forcing learners to take responsibility and make judgments they are not equipped to make. Instead of being pleased about opportunities to form their own opinions and judgments, they may be confused and intimidated by this reversal of their expectations about education (Brookfield ,1992).

Sensitization or awareness of the surveyed issues may cause a subject to react differently since they are suddenly aware of the problem. This threat could be a factor as subjects may develop a negative reaction to supplying a third party, especially local and federal governments, with information about how they make decisions, or that they do

not use computers when it is popular to do so. Historically and currently prevalent in Montana is a ground swell of mistrust directed at the government (Stern, 1996).

Population Description

Approximately 8,000 private pesticide applicators are licensed in Montana. For re-certification purposes, the state is divided into 5 regions with rotating programs offered among region to obtain credits necessary for license renewal. In addition, many applicators become new licensees each year either by attending an Extension Service sponsored pesticide-training program or through a self-study program available at county Extension office.

> A private applicator may be certified in one of two ways:
> "1. Obtain at least six credits of approved training over a five-year period. This training can be obtained during the five-year re-certification period or all in the last year of re-certification. It is recommended that applicators have the opportunity to obtain some training in each of the five years during the re-certification period.
> 2. Re-certification requirements may change to 12 credits with some training occurring during each year.
> OR
> 3. If six credits are not obtained by the end of the fifth year and the applicator wishes to re-certify, he/she must take a closed book written exam and answer 70% or more of the questions correctly. The applicator cannot enter the system as an initial certified applicator for a period of two years from the date of re-certification" (Montana Pesticide Education Program 2001, [Online]).

Sample and Time Line Description

In 1997, the PRN project received USDA funding to develop an electronic pest recommendation network for pesticide applicators in Montana. Grant objective 1,

programing of the software application and Grant objective 2, development of the initial case information was also completed in 1998. On the other hand, delivery of training allowing PAT participants to use the WWW based PRN, proved difficult because the Montana 1998 - 1999 PAT training was underway in Western Montana or Region 1. The PRN contains cases that reflect situations common to small grain pest management. However, Western Montana or Region 1 includes very little small grain production. Therefore, delivery of PRN training to PAT workshops in Region 1 would have been ineffective. In 1999 - 2000, PAT was underway in Region 2, an area that contains suitable small grain production. Small grain producers were likely to find the cases in the PRN useful and so the study was scheduled for delivery to PAT workshops in Region 2 during the 2000 season.

Results of Survey Instrument Testing

To improve the over all design, return rate, validity, and readability, the survey was pilot tested by faculty in the Education Department, and during the Gallatin and Granite Counties Pesticide Applicator re-certification session in December 1999. Seventy four participants (possible 220) were surveyed in the instrument test.

The results of survey section II indicated that greater than 50% of the participants have or lease a computer or Web TV, have access to email, and access to the Web or the Internet. Survey Section III asked the participant what factors affected their use of the Internet. Familiarity with what the WWW offers ranked as having the most effect on the participants use of the WWW, followed by lack of technical assistance or training.

Telephone and monthly telephone charges ranked last. In order to align the format and structure of information included in the PRN the survey asked participants to rank the value of selected pest control factors to their pest control decision making. Chemical control information, pest life cycle, conditions favoring susceptibility and economic thresholds ranked above typical infestation patterns, cultural control information, symptoms and look alike symptoms. These results served to support the assumption that producers had access to computers and the Internet.

Following the survey test, the instrument was discussed with advisors and people experienced with conducting surveys and portions were revised where necessary. Following the testing and revision process the instrument was approved .

Using the tested instrument, 540 pesticide applicators were surveyed from a Region 2 population of approximately 1757. Forty three surveys were discarded so in the study, the total sample was made up of 497 new and returning pesticide applicators attending the 2000 Region 2 PAT re-certification session in Great Falls, Montana. No attempt was made to determine gender or minority.

Table 1. Frequency of PAT participants responding to pre-training paper survey.

County	Area Total	Attendees	Surveys Returned	Surveys Completed*
Region 2 survey	1700	540	540	497

* 43 surveys were incomplete and discarded.

Participants were asked to circle terms (Private, Commercial or Restricted) that described their PAT Applicator type most accurately. The PAT session was designed

and advertised as suitable for private applicators and the data in Tables 1 and 2 indicated that the private applicator (437) and producers (413) were a large majority of attendees.

Table 2. Types of Pesticide Applicators Participating in Survey.

Applicator Type	Number	%
Private Applicators	437	88
New Applicators	40	.08
Restricted	10	.02
Commercial	6	.01
Private and Commercial	4	.008

Table 3. Types of Careers Participating in Survey.

Career Type	Number	%
Producers	413	83
Agricultural Business	16	3
Both a Producer and Ag. Business	16	3
Certified Crop Advisor	1	.1
Career type not indicated	51	10

Similarity of the Samples

To determine if the control and trained groups were from the same population a Mann-Whitney and Wilcoxon Test was applied using the SPSS Base 10.0 package. Differences in the two groups were not significant at .05 (except for Variable 4 "Economic pest control thresholds" in Section I), so the groups were treated as similar.

Instrument Design: Pre-session Survey on Paper

A list of factors that might affect a pesticide applicator's decision to use electronic methods to access PRN, were collected and identified from the literature, and through conversations with agricultural educators and researchers in the Department of Agricultural and Technology Education. A Likert-type scale, employing responses ranging from zero (0) to eight (8) for section I (Pest Control Information Needs) and zero (0) to five (5), with a "Not applicable" option (Factors Influencing Your Current use of the World Wide Web Network). A zero indicated that a factor had no Pest Control value to the participant or effect on a PAT participants use of the PRN. Eight to five indicated that the factor had high value for pest control or a "strong effect" on the PAT participants use of the PRN.

The survey instrument consisted of different sections (Appendix A). The first section asked questions to determine the value of pest control factors in the PAT participants pest control decision-making. For this section, the "Not Applicable" response was not included. This approach forced respondents to make a decision regarding the potential impact of each factor on the future implementation of PRN information in pest management decisions.

The second section (Internet Access) asked participants about what kind of computer resources they had and the third section (Factors Influencing Your Current Use of the World Wide Web) contained questions about the value of selected factors that may