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Cano, Jamie M., Ph.D.
The Ohio State University, 1988
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UMI
ASSESSMENT OF THE LEVEL OF COGNITION OF
INSTRUCTION AND STUDENT PERFORMANCE IN SELECTED
PRODUCTION AGRICULTURE PROGRAMS IN OHIO

DISSERTATION

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

By
Jamie M. Cano, B.S., M.A.

* * * * * *

The Ohio State University
1988

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Adviser
Department of
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DEDICATION

This work is dedicated to my wife, Evelyn, and children, Evette and Matthew. Without them, my education would not have been possible, nor would my life have meaning.
ACKNOWLEDGEMENTS

The author is extremely grateful to the many persons who have provided cooperation, guidance, and counsel in the preparation of this dissertation and throughout my graduate program. Specifically, the author would like to express sincere appreciation to the following individuals.

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To my wife, Evelyn, for her understanding, encouragement, love, and support during the course of my educational pursuit. Maybe now you can get some desperately needed rest.

To my daughter, Evette, and son, Matthew, for their patience and sacrifices throughout "daddy's" graduate program.
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Studies in Teacher Education:

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CHAPTER I
INTRODUCTION

Public schools are dedicated to the preservation of our democratic society through the education of our youth. The democracy in which we live calls for increasing ability to understand and to live with other people. Therefore, it is important that public school teachers teach the fundamental skills and develop attitudes and habits that will help the student to be a useful citizen in our democracy. Included is the development of mental, physical, moral, and social habits in order that the student may reach his/her maximum ability.

Vocational education, also must give purpose and meaning to education by relating instruction to occupational goals. Obviously, vocational education must provide the technical knowledge and work skills necessary for employment. But, the educational training shall be more inclusive than training for job skills. Educational training must contribute to the development of the cognitive, psychomotor, and affective domains of learning.

Vocational education should be a part of a broad program of studies aimed at developing economically, socially, emotionally, and physically competent adults.
Specifically, programs in agricultural education, should be aimed at preparing the student for employment in an agricultural occupation and for preparation of the student for continuance in post-secondary educational programs.

Bloom, Madaus, and Hastings (1981) labeled education as a "process of change;" students must be changed in some way through the instruction they receive. Such change is that of developing the abilities required to become a successful citizen in our society. Such abilities include (1) the ability to communicate intelligently and effectively; (2) the ability to evaluate existing products and ideas and create new ones; (3) the ability to think and perform independently; and (4) the ability to transfer and apply curriculum-based knowledge to career-based situations (Newcomb & Trefz, 1987). Learners are no longer passive receptacles standing ready to receive whatever information and knowledge teachers wish to pour into them (Nickerson, 1984).

Teachers at all educational levels and subject areas in America's public schools have been concerned with the actual types of learning taking place in their classrooms. Teachers of agriculture, specifically production agriculture teachers, are no exception and are concern about the type of learning taking place in their classrooms.

A half century of educational literature suggests that the main emphasis in schools is teaching students facts,
even though teachers and curriculum designers attest to the importance of teaching students to think (Gall, 1970; Roberts, 1974). Newcomb and Trefz (1987) in a study of college professors of agriculture, stated that professors of agriculture concern themselves with subject matter their students learn, and are less concerned about the cognitive level of instruction. In addition, the professors of agriculture, are less concerned about the cognitive level of performance by the students (Newcomb & Trefz, 1987).

This researcher contends that not only teachers of agriculture at the college level, but all teachers of agriculture, at all educational levels, practice the pattern of teaching that Newcomb and Trefz (1987) suggest. If students are limited to repeating back to the teacher that which was given to them, then not much instruction of an enduring nature has occurred. And, if insufficient instruction occurs at the higher levels of cognition, then students are not graduated adept at problem solving, analysis, and evaluation (Newcomb & Trefz, 1987). This lack of concern on the teachers' behalf may not only lead to a lowered teaching standard, but may well lead to a lowered level of competence on the students' behalf.

Statement of the Problem

Although the libraries abound with past research volumes which have studied cognitive development (Ryan, 1973; Anderson, 1973; Chamberlain & Kelly, 1981; Roberts,
agricultural educators are unable to use past studies to determine the level of cognition of instruction taking place in America's vocational agriculture classrooms. Previous research does not apply to vocational agriculture programs specifically because the populations studied or the methodologies utilized in these studies did not include vocational students. Furthermore, the researchers do not acknowledge any differences or similarities among vocational students and the populations studied. As a result, agricultural educators do not know at what level of cognition students in production agriculture classrooms are performing or at what level of cognition the students are capable of performing.

The purpose of this study was to determine the cognitive level of instruction in the classroom as outlined in the courses of study by selected production agriculture teachers from public schools in Ohio. Furthermore, this study sought to determine the level of cognition at which students in production agriculture classes were performing.

Research Questions

The following research questions were investigated.

1. How can the selected production agriculture teachers be described in terms of age, marital status, gender, program enrollment, number of years in the teaching profession, highest educational degree attained, and number of years in their current position?
2. What subject matter was taught by the selected produc­tion agriculture teachers during the 1987-1988 academic year based upon an examination of their courses of study?

3. What was the cognitive level of instruction utilized by the selected production agriculture teachers as measured by the Newcomb-Trefz Model based upon the teachers' courses of study?

4. To what extent did the cognitive level of instruction differ among the grade levels (ninth, tenth, eleventh, and twelfth) and subject matter areas as indicated by the teachers' courses of study?

5. To what extent did the students of the selected produc­tion agriculture teachers perform at the various levels of cognition based upon a researcher developed written test?

6. What was the relationship between the level of cognition of instruction as measured by the teachers' courses of study and the cognitive performance level of the students?

**Limitations of the Study**

This study was descriptive and relational in nature. A relational study cannot establish cause-and-effect relationships among variables (Borg & Gall, 1979). Therefore, the investigator sought only to describe and explain relationships among characteristics. The data utilized in this
study were obtained from the courses of study of selected production agriculture teachers and from a researcher-developed written test administered to the twelfth-grade students of the selected teachers of agriculture.

The criteria used to identify the production agriculture teachers and the size of the sample used in this study were identified as limitations. The generalizability of the results was limited to the selected production agriculture teachers and their twelfth-grade students.

**Definition of Terms**

**Lesson Plan:** Plan of instruction for a single class period.

**Level of Cognition:** The level identified in Bloom's Taxonomy for classifying objectives and questions based on the type of cognitive process required to fulfill the objective or answer a particular question (Andre, 1979).

**Need for the Study**

In 1943, a committee of college and university examiners began to develop a system for classifying the goals of the educational process to facilitate communication among one another about testing, measurement, and the evaluation of learning. This work resulted in Bloom's (1956) Taxonomy of Educational Objectives: Cognitive Domain which identified six categories of cognitive or intellectual activity (Figure 1) going from the acquisition of knowledge to the ability to make evaluations using appropriate criteria.
The Taxonomy of Educational Objectives

Cognitive Domain

Evaluation
Synthesis
Analysis
Application
Comprehension
Knowledge

Figure 1: Bloom's Taxonomy of Educational Objectives (1956). A Hierarchical Order.
Although Bloom's work was originally intended as a classification of educational goals, the Taxonomy has had a secondary function in that it represents a useful inventory of cognitive skills and abilities against which teachers can gauge the variety and range of their own teaching goals. Lessinger (1963) and Lombard (1965) stated that in addition to the Taxonomy being used as a useful guide for the development of objectives, it is also used for designing test items which would measure whether stated objectives have been achieved. Whatever form or means the instructor chooses to assess student achievement, instructional objectives must serve as the basis for a valid and purposeful evaluation (Clegg, Manson, Ochoa, Nichols, & Williams, 1968). In Ohio, instructional objectives for vocational agriculture programs, can be found in the course of study.

Educators in general have been concerned about the level of cognition utilized in the classrooms as the related literature suggests (Ryan, 1973; Anderson, 1973; Chamberlain & Kelly, 1981; Roberts, 1974; Furst, 1981; Gall, 1970; Willson, 1973). Most studies that have measured the level of cognitive instruction indicate that most teacher questions call for lower level thinking; the recall of factual information (Ryan, 1974; Gall, 1970).

The previous research studies have been conducted with traditional school programs such as science (Blumber, Alschuler, & Rezmovic, 1982; Billeh, 1974), English (Moyer,
1965; Purves, 1971; Moore & Kennedy, 1971), social studies (Schreiber, 1967; Orlandi, 1971; Hunkins, 1969), and computer based education (Hall, 1983). Thus, agricultural education programs have not been the focus of the previous research.

This study will assist agricultural educators by defining what subject matter is being taught to high school vocational agriculture students and at what cognitive level. If the majority of the teaching is at the lower cognitive levels, and the students are able to perform at higher cognitive levels, then instruction must be altered to meet the challenges that the students expect. Some researchers have shown that teachers (Davis, Morse, Rogers, & Tinsley, 1969; Gall, 1970; Sloan & Pate, 1966; and Willson, 1973), as well as students (Hunkins, 1969), could be trained to develop and use higher order objectives, thereby raising cognitive levels.

Specifically, this study will offer agricultural educators knowledge about the levels of cognition of instruction utilized in the selected production agriculture programs both by grade level and subject area. This information will be extremely useful to teacher educators in agriculture.

The Department of Agricultural Education at The Ohio State University offers a course entitled "Methods in Teaching Agriculture" which is a prerequisite for teacher
certification in Ohio. The data from this study could be incorporated into the content of the existing course in an effort to instruct the preservice teachers that delivery of instruction should vary between grade levels and between subject areas. There is a paucity of research which reflects an examination of the crucial issue of whether a significant relationship exists between the kinds of objectives or questions formulated or posed by teachers of agriculture (low level, high level) and any resultant student behavior.

The decade of the 1980s and certainly the 21st century will not only require, but demand from agriculturalist, the latest knowledge and skills about agricultural concepts. Nelson and Scanlon (1977) reported that preparing students for the world of work is an important function of education. Vocational agriculture students must be given the opportunity to develop the skills, attitudes, and knowledge necessary for success in the world of work.

Miller and Cano (1986) found that agribusiness owner/managers reported that the students graduating from high school, who had previously enrolled in vocational agriculture classes, did not possess the knowledge and skills required for today's agriculture. Furthermore, in this same study, Miller and Cano (1986), reported that the adult workforce was not able to meet the demands of today's agriculture.
Vocational agriculture graduates need to have the ability to think and respond at higher cognitive levels. Consequently, teachers of vocational agriculture, need to teach at the higher cognitive levels if the demands of agriculture for the 21st century are to be met.

The results of this study should provide a basis for making recommendations related to the improvement of educational objectives for vocational agriculture programs in Ohio.
CHAPTER II
REVIEW OF RELATED LITERATURE

The dialogues of Socrates and dialectics of Plato have often been considered the epitome of intellectual discourse, and have been used throughout history as a model for all teachers (Clegg, Manson, Ochoa, Nichols, & Williams, 1968). However, in modern history, there has been one individual who revolutionized cognitive development.

Jean Piaget was by far the most important single figure of all those who have ever studied cognitive development (Meadows, 1983). Rotman (1977) stated that Piaget dominated the study of cognitive development for half a century.

In America, experimental research in psychology has typically concerned itself with hypothesis testing, rigorous control of experimental variables, and treatment of data with sophisticated procedures. Most of Piaget's research was not experimental, nor did he employ elaborate statistics and test hypotheses.

From his work in Paris in Binet's clinic, Piaget evolved a clinical descriptive technique that came to serve as a trademark for his work. The clinical descriptive technique essentially involved asking individual children carefully
selected questions and noting their responses. In other cases, data were nothing more than the observation of child behavior.

These techniques were invariably systematic and Piaget's analysis was exceedingly detailed and designed to detect developmental changes in cognitive functioning. Piaget's research technique was one of systematic observations, detailed descriptions, and a detailed analysis of behavior. From these exceedingly complete and careful descriptions of behavior over a period of time, major conclusions have been drawn regarding intellectual development, but not without criticism.

Piaget's research has been criticized severely by some researchers because of the small "sample size," and because it was not experimental. The criticisms, however, diminish in importance if one accepts the assumption implicit in Piaget's theory: that the general course of development of intellectual structures is the same in all persons. If this is true, then sample sizes become meaningless (Meadows, 1983).

Despite the criticisms of Piaget's work, many research efforts have been stimulated by Piaget's Theory of Cognitive Development. Using Piaget's stage of cognitive development, many studies have attempted to describe the level of thinking that is characteristic of the typical student.
Studies in recent years have suggested that students may still operate mostly at the stage of concrete thinking, with regard to Piaget theory (Collea, 1981; Day, 1981; Taylor & Dunbar, 1983). A student who operates at this level tends to learn basic facts, but may not be ready to generate new knowledge based on those facts.

Piaget maintained that proper education can accelerate the cognitive transition from a concrete to a formal stage which is a more desirable level of thinking (Taylor & Dunbar, 1983). Dressel and Mayhew (1954) identified some abilities that are related to the concept of critical thinking. Those abilities were: (1) the ability to define a problem; (2) the ability to select pertinent information for the solution of a problem; (3) the ability to recognize stated and unstated assumptions; (4) the ability to formulate and select relevant and promising hypotheses; and, (5) the ability to draw valid conclusions and judge the validity of inferences. These abilities are related directly to the lesson objectives and the questions teachers ask during the instructional period.

In the early to mid 1960s, a number of studies pointed out that the objectives teachers set and the questions teachers asked most frequently were of the lowest order intellectually, requiring little more than the recall of memorized material (Floyd, 1961; Gallagher, 1965; Davis & Tinsley, 1967). Gallagher (1965) concluded that the
limitation of low level questioning increases the likelihood of divergent or creative activity on part of the pupils. It must be noted, however, that researchers did not use the same techniques or methods to categorize the learning behaviors.

Many researchers have developed individual methods to categorize learning behaviors. Much of the attention, however, has been given to classroom questioning practices and instructional objectives and their relationship to student learning. Whatever form or means the teacher chooses to assess student achievement, instructional objectives must serve as the basis for a valid and purposeful evaluation.

The concern for evaluation of instructional objectives and teacher questions is reflected in the fact that at least eleven classification systems (Adams, 1964; Aschner, 1961; Bloom, Englehart, Furst, Hill, & Krathwohl, 1956; Carner, 1963; Clements, 1964; Gallagher, 1965; Guszak, 1967; Moyer, 1965; Pate & Bremer, 1967; Sanders, 1966; Schreiber 1967) were developed in the 1950s and 1960s with the common purpose being to assist teachers to identify cognitive levels in their intended objectives (Ryan, 1973).

In recent years, other classification systems have been developed. Newcomb and Trefz (1987) and Stiggins (1986) developed derivations of Bloom's (1956) model for their respective research. Both the Newcomb-Trefz (1987) and
Stiggins (1986) Models are valid.

Several systems, such as Bloom's (1956), Gallagher's (1965), and Carner's (1963) consist of a limited number of general categories which can be used to classify questions and instructional objectives irrespective of context. This feature enables the researcher to investigate issues such as the different types of questions or instructional objectives emphasized in various forms of the school curricula (Pfeiffer & Davis, 1965).

One of those systems, The Taxonomy of Educational Objectives Handbook I: Cognitive Domain (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956) is a classic system which has dominated instructional design and evaluation for over a quarter of a century (Stahl & Murphy, 1981). Known as "Bloom's Taxonomy," this system still influences curriculum development and test construction today.

Bloom's Taxonomy can be used to classify cognitive thought and associated behaviors into six hierarchical levels. The levels identified in Bloom's Taxonomy for classifying objectives and questions are based on the type of cognitive processes required to fulfill the objective or answer a particular question (Andre, 1979). Classification of objectives and questions are fundamental to guide student learning.

Moody (1982) stated that at the onset of any course of study, the student should understand the content of the
course and what is expected of the student. Use of Bloom's Taxonomy as a framework for learning structure gives focus and direction for teachers interested in improving the quality of learning in their classrooms by analyzing and evaluating course objectives in terms of the level of cognitive processing demanded from the students.

Bloom's Taxonomy of Educational Objectives

The six levels defined in Bloom's Taxonomy are: knowledge, comprehension, application, analysis, synthesis, and evaluation. The levels are presented in a hierarchical order, with knowledge being the simplest process and evaluation rated as the most complex. Each level serves as a prerequisite skill for the next higher level (e.g., knowledge is required before comprehension can occur; application involves the use of both knowledge and comprehension, etc.). A more detailed description of the levels of cognition is provided in Appendix A.

Research Related to the Taxonomy

In spite of its widespread utilization, the Taxonomy has caused many to study it closely to determine its validity and value to education since the 1960s. However, the results of these studies have been inconclusive and tend to suffer from methodological flaws (Furst, 1981; Fain & Bader, 1983). Nonetheless, the research concerning Bloom's Taxonomy falls into two major categories: (1) studies questioning its validity as a hierarchy of thought, and
the actual application of Bloom's Taxonomy in measuring classroom-related cognitive behavior (Roberts, 1974).

Validity as a Hierarchy

There is some question as to whether the taxonomic levels do exist in a hierarchy, as research into this question has produced conflicting findings. A research review conducted by Willson (1973) found some empirical studies (Gall, 1970; Hunkins, 1969; Kropp, Stoker, & Bashaw, 1966; Scriven, 1967; Stanley & Bolton, 1957; Smith, 1970) which support the validity of the hierarchy. Madaus, Woods, and Nuttall (1973) contended the hierarchy exists for the first four levels (knowledge, comprehension, application, analysis), but found the analysis-synthesis and synthesis-evaluation links to be weak. Miller, Snowman, and O'Hara (1979) supported Madaus, Woods, and Nuttall (1973) in the acknowledgement that a hierarchy may exist for the first four levels (knowledge, comprehension, application, and analysis), but that a split occurs between the analysis and application phase and between the synthesis and application phase (Figure 2). However, Miller, Snowman, and O'Hara (1979) contend that there is a linear relationship between synthesis and evaluation.

Thus, the interpretation of the Taxonomy is a major concern (Furst, 1981). Kunen, Cohen, and Solman (1981), Furst (1981), and Fain and Bader (1983) questioned whether the six categories of knowledge, comprehension, application,
Figure 2. Miller, Snowman, O'Hara (1979) branched model of Bloom's Taxonomy hierarchy.

Analysis, synthesis, and evaluation are in the correct order hierarchically. For example, Kunen and others (1981) concluded that the synthesis and evaluation categories were found to be in the wrong order in a number of studies. Stedman (1973) found no significant difference between knowledge and comprehension or comprehension and analysis.

Certain writers in education (Pring, 1971; Orlandi, 1971; Purves, 1971) have suggested that activities (instructional as well as testing) aimed at a lower level in Bloom's
Taxonomy may activate mental operations placed in the synthesis and evaluating categories in Bloom's Taxonomy. Pring (1971) agreed that comprehension of principles must include the ability to apply principles to new situations. Orlandi (1971) implied that meaningful comprehension in the social studies must be accompanied with or preceded by analysis. Purves (1971) took a similar view with respect to the field of English literature. Working in language arts, Moore and Kennedy (1971) took the position that some analysis must be undertaken before application can be processed.

Several authorities have considered evaluation inherent in synthesis and, therefore, not superordinate (Foley, 1971; McGuire, 1963; Ormell, 1974; Willson, 1973). Empirical evidence also suggests that the evaluation category should not be placed higher than the synthesis category in Bloom's Taxonomy, but at best be parallel with it (Kropp & Stoker, 1966; Madaus, Woods, & Nuttall, 1973).

In spite of the limitations discussed, Bloom's Taxonomy has provided a helpful conceptual framework for evaluation of teacher questions and instructional objectives (Fain & Bader, 1983). Altogether, these various exceptions suggest that dissecting the cognitive domain into distinct, linearly ordered categories has drawbacks. In conclusion, Bloom and others (1956) did acknowledge that it was not possible to make as clear-cut distinctions as one would like.
Application in Classroom-Related Activities

The actual application of Bloom's Taxonomy to the classroom related cognitive behaviors, the methodological weaknesses identified in the studies validating the hierarchy are also found (Furst, 1981; Fain & Bader, 1983; Roberts, 1974). Some evidence does suggest however, that a positive relationship may exist between the level of the teacher's questioning and student achievement (Winne, 1979). Billeh (1974) concluded that the level of teacher's questions had a direct relationship to the cognitive level that the students have to employ to arrive at satisfactory responses to the questions.

In most studies conducted, researchers (Gall, 1970; Ryan, 1974; Floyd, 1961; Gallagher, 1965; Davis & Tinsley, 1967) have determined that most teachers' questions call for a lower level of thinking -- the recall of factual information. In a study of teachers' questioning practices, it was found that 60% of teachers' questions require students to merely recall facts that have been presented them, about 20% are procedural in nature, and only 20% require students to actually engage in thought beyond the level of recalling facts (Gall, 1970).

Another group of researchers (Billeh, 1974; Bloom & others, 1956; Bloom, 1972; Davis, Morse, Rogers, & Tinsley, 1969; Doak, 1970; and Gall, 1970) concluded that both the test and teacher questions classified in their respective
studies, generally fell into the lowest level of Bloom's Taxonomy, knowledge.

A main thrust of the research done on questioning has focused on such characteristics of teacher questioning practices as the number of questions a teacher asks over a period of time (Moyer, 1965; Stevens, 1912), the amount of teacher versus student talk in the classroom (Flanders, 1970), and the levels of teacher questioning (Hoetker & Ahlbrand, 1969).

Utilizing Bloom's Taxonomy, Hunkins (1969) found that students guided in their study of social studies textual material by a preponderance of analysis-evaluation questions scored significantly higher on a posttest of achievement than those students guided by a preponderance of knowledge-type questions written for the same materials. Kirts and Stewart (1983) concluded that agriculture student teachers who used a problem solving approach to teaching, asked more questions of both higher and lower levels than other student teachers who did not use the same approach to teaching. The results of three inter-related questioning studies indicated that achievement of students was significantly and positively affected by higher level teacher questioning (Buggey, 1972; Tyler, 1980).

Cognitive levels may be influenced to some extent by such factors as teacher characteristics and the nature and level of the subject matter being taught. Billeh (1974)
included these factors in a study of high school science courses and concluded that teachers with more experience seem to ask more questions requiring lower levels of cognition. Fincher (1977) determined that the years of teaching the course had a negative relationship with the students' cognitive level of achievement. Billeh (1974) further concluded that question levels did not differ among different science subjects and different grade levels.

**Summary of Research on Bloom's Taxonomy**

At present, there has not been any other classification system more applicable and which has received as much attention from researchers in attempting to validate as Bloom's Taxonomy. Many teachers and researchers still find Bloom's Taxonomy valid for use in assessing the cognitive level of instructional objectives and teacher questioning (Gall, 1970). Thus, the evidence leans toward the use of Bloom's Taxonomy as a valuable formative and summative evaluation tool. The widespread use of Bloom's Taxonomy in textbooks and curriculum guides still exists today, and attests to its relevancy and effectiveness (Carin & Sund, 1971; Ryan, 1973).

Hierarchical schemes may consist of categories of mental operations but ultimately the referents of these hierarchical schemes must center on cognitive tasks and products. Bloom's Taxonomy (1956) is based on the premise that the referents of the hierarchical scheme centers on cognitive
tasks and products. The same premise that hierarchical schemes consist of categories and that the referents of these schemes center on cognitive tasks would also be true of Piagetian analysis of the formal properties of knowledge, touted by Travers (1980) as an alternative to the earlier Taxonomy.

Finally, if one accepts the premise that subject matter cannot be completely divorced from the development of taxonomies of educational objectives, a strong case can be made for a logical mapping of objectives in the several basic domains of knowledge (Hirst, 1974). No single scheme would emerge as an all-inclusive, all-purpose tool for the evaluation of cognitive development. Therefore, based upon the common acceptance of the hierarchy at the lower levels and the disagreement concerning synthesis and evaluation, for the purposes of this study, synthesis and evaluation will be considered as being equal, but will be categorized separately. Newcomb and Trefz (1987) have renamed these two categories (synthesis and evaluation) creating and evaluating in a study conducted in higher education.

Newcomb-Trefz Model

Using a modified model of Bloom's Taxonomy (1956), Newcomb and Trefz (1987) developed a method of assessing the cognitive level of questions used in examinations and student assignments in the College of Agriculture at The Ohio State University. With the assistance of David
Krathwohl, one of the authors of Bloom's Taxonomy, Newcomb and Trefz (1987) developed the modified version of Bloom's Taxonomy (Figure 3) for use in the College of Agriculture study.

Bloom's original level of knowledge was kept intact conceptually, but was renamed to remembering, to more accurately describe the type of behavior required to function at this level. Questions at the remembering level involve no more than a recall of information presented to the
student (Bloom & others, 1956).

Bloom's levels of comprehension, application, and analysis were combined to form one level called processing. In a later work (Bloom & others, 1981), application and analysis were described as being further steps in the true understanding of material. The distinctions between these three levels are rather fine, thus Newcomb and Trefz (1987) concluded that the hierarchy could be simplified if combined into one level called processing. Processing level questions require an understanding of the information and its use in a procedural manner.

The level of synthesis remained conceptually the same, but was renamed creating, to more accurately reflect the behavior required of activity at that level. Questions at the creating level require the combination of information in a form that is new to the student; to create a new product.

The level of evaluation from Bloom's Taxonomy was kept the same. Evaluating-level questions require the student to use the information in making an independent judgement or evaluation. A more complete description of the Newcomb-Trefz (1987) Model descriptors is found in Appendix B.

The Newcomb-Trefz Model tends to concur with the findings of Aschner. Aschner (1961) concluded that teacher questions trigger four types of thinking activities: remembering, reasoning (processing), creative, and evaluating.
Developing Objectives

Educational objectives provide a student with a "blueprint" of what is considered to be important in a given course. Carefully developed objectives can also create a common understanding between the teacher and student as to what information will be provided by the teacher as well as what is expected of the student. Instructional objectives also provides the student some direction as where to best devote learning efforts.

Bloom's Taxonomy can serve as an invaluable tool for teachers concerned with the effectiveness of behavioral objectives developed for their courses. For teachers struggling with the problem of stating objectives, Bloom's Taxonomy provides a common point of reference and common terminology (Bloom & others, 1981).

A taxonomy-based vocabulary list has been prepared by several authors (Clegg, 1967; Chamberlain & Kelly, 1981; Hall, 1983; Newcomb & Trefz, 1987) to assist teachers in developing course objectives as well as test items. A compilation of these lists is included in Appendix C.

Bloom's Taxonomy also calls the teacher's attention to the possibility of measuring objectives more complex than the recall of facts. Providing students with behavioral objectives directed at more complex thought processes and behaviors helps prepare the student for higher-level questioning which may occur in classroom discussion and
subsequent student assignments and tests (Forehand, 1974).

Having established goals and objectives which accurately describe the expectations for the course, it is essential to further structure the learning by delivering instruction in such a way which will adequately prepare students for the cognitive levels utilized in the program of instruction.

**Instructional Delivery**

Bloom (1956) was not able to determine, from research, whether one kind of behavior is retained for a longer period of time than another, or which kinds of educational experiences are more efficient in producing a particular behavior. However, a study conducted by Blumber and others (1982), determined that greater depth of processing upon acquisition of the material facilitates later retrieval and usage.

The nature of questions utilized during classroom learning has a dramatic effect on the student's ability to later utilize the information (Young, 1982). Taba (1966) attempted to identify questioning strategies that stimulate students to reflect on material in an increasingly abstract level. Gall (1970) and Taba (1966) advocated that teachers should start a discussion by asking recall questions to test student's knowledge of facts and then ask higher cognitive questions that require manipulation of these facts. Gall (1970) further hypothesized that follow-up questioning of the student's initial response has substantial impact on student learning in classroom teaching situations.
Although classification of higher-level questions has been examined and clarified, little is known about what constitutes good answers to these questions. Gall (1970) suggested the following criteria for evaluation of higher-level questions: (1) complexity of the response; (2) use of data to justify or defend the response; (3) plausibility of the response; (4) originality of the response; (5) clarity of phrasing; and, (6) the extent to which the response is directed at the questions actually asked.

Providing a background of facts, dates, and theories, is essential for the student beginning to learn new subject matter. Avoidance of such fundamental instruction would deprive students of a point of reference or foundation for further learning. However, when educators fail to elaborate on such facts, or do not assist students with developing a deeper understanding which will enable them to apply their knowledge in new and challenging situations, the full potential of education cannot be realized. The mere knowledge of facts is not a sufficient goal in education. It is only when students can make the transition from the curriculum to the real world and can express their knowledge in ways relevant to the situations facing them that their education has truly been beneficial to their growth and development.

In a study conducted on the relationship of intelligence and creativity to Bloom's Taxonomy, Smith (1970) indicates
the first four levels (knowledge, comprehension, application, and analysis) suggest the need for intellectual ability only. However, he found the definition of synthesis and evaluation indicate that creative behavior is required on the part of the learner.

Synthesis questions encourage students to utilize creativity and originality in their thinking. As Sanders (1966) pointed out, cultivating creative thinking requires more than asking questions in the synthesis category. It is essential that a classroom atmosphere be created that encourages divergent thought. The teacher, as well as fellow class members, should show respect for unusual answers by listening to them, discussing and challenging them, and giving credit for them.

A teacher must possess certain personality characteristics to be successful in encouraging creativity. The teacher must be willing to diverge from the original pattern of instruction and gain satisfaction from a new idea created by a student (Sanders, 1966). The benefits derived from such efforts will later return profits by fostering the increased use of independent student thinking.

Test Construction and Analysis

Bloom (1956) stated that the task of classifying test items is more complicated than that of classifying educational objectives. The learning situation which preceded the test must be known or assumed before a particular test
question can be classified.

To classify a question in its "level" refers to the nature of cognitive processing required to answer the question (Andre, 1979). Criteria have been developed from a number of sources (Bloom & others, 1956 and 1981; Chamberlain & Kelly, 1981; Hunkins, 1972; and Sanders, 1966) to serve as a guide in classifying test items. For the purposes of this study, using the Newcomb-Trefz Model, Appendix D provides the criteria for question classification.

**Teacher Training in Cognition**

Two of the most frequently used guides to the cognitive level of teachers' questions and instructional objectives has been Bloom's *Taxonomy* (1956) and Sander's *Classroom Questions - What Kind?* (1966). Studies conducted by Clegg, Farley, and Curran (1967), and replicated by Farley and Clegg (1969), have shown that given some training in the knowledge and usage of Bloom's Taxonomy (or in a form modified by Sanders, 1966) that teachers ask significantly more questions at higher cognitive levels than teachers who have not had such training. In addition, these studies (Clegg, Farley, & Curran, 1967; Farley & Clegg, 1969) have concluded that a high degree of agreement could be obtained within and between several groups of raters, suggesting the conclusion that Bloom's Taxonomy could be used as a common language in education for inservice or preservice training.
of teachers.

When the development of higher cognitive skill questions and abilities has been so highly regarded by researchers in cognitive development, why then do teachers rely on the use of recall questions? Gall (1970) hypothesizes that it is because teachers do not realize the need for asking more thought-provoking questions. Or, could it be that the teachers lack expertise necessary to question more effectively? Clegg and others (1968) have found that given training in the knowledge and use of the levels of learning derived from Bloom's Taxonomy, teachers ask significantly more questions at higher cognitive levels than those who have not had such training.

However, there is a lack of effective training programs which focus on the utilization of higher-level questions by classroom teachers. Training in questioning behavior leads to an increased awareness of that behavior and some increase in the cognitive interaction between student and teacher (Willson, 1973).

Training could be as simple as pointing out to preservice and inservice teachers that they need to ask many fact or recall questions to bring out the data required to answer higher level questions (Gall, 1970). Gall (1970) further suggested that by using follow-up questions after a student's initial response to a recall question (e.g., "how would that solve the problem" or "what makes you say that")
has a substantial impact on student learning in classroom teaching situations and moves students into higher levels of cognitive thought.

There may be times when the nature of the subject matter is not conducive to higher-level questioning. Kropp and Stoker (1966) found that questioning was made much easier when an outline of the subject matter was created to clarify the theory and logic of the subject matter. By creating an outline of the subject matter to be taught, the teacher will make it much easier to determine if higher-level questions can be effectively written.

Kropp and Stoker (1966) also discovered that question formation involving the different cognitive levels was made much easier by creating the questions in a "round robin" fashion (one question was formulated from each cognitive level, and then the cycle was repeated). Initially all items in the study (Kropp & Stoker, 1966) were prepared at the lowest level first and then moved up the hierarchy. The idea of preparing lower level questions first and then moving up the hierarchy was quickly abandoned; quite often the material did not provide enough testable information to provide good synthesis and evaluation questions after other types had been prepared.

Summary

This review of literature on cognitive development suggests that there is a need for, or at least an interest
in, classification of cognitive operations and objectives. Not all who opt for a classification system insist on one organized as a hierarchy. But for some, the notion of a hierarchy has much appeal. Perhaps those that argue for a hierarchical system are justified in that a hierarchy is fundamental in the make-up of skills, abilities, and knowledge of subject matter.

A literature review has unveiled at least a dozen studies which have attempted to support (Gall, 1970; Hunkins, 1969; Kropp, Stoker, & Bashaw, 1966; Scriven, 1967; Stanley & Bolton, 1957; Smith, 1970) or not support (Madaus, Woods, & Nuttall, 1973; Miller, Snowman, & O'Hara, 1979; Kunen, Cohen, & Solman, 1981; Furst, 1981; Fain & Bader, 1983) Bloom's Taxonomy. Despite the research efforts by many scholars, a firm conclusion about the validity of Bloom's Taxonomy cannot be drawn. However, Stahl and Murphy (1981) have labeled Bloom's Taxonomy as a "classic system" which has dominated instructional design and evaluation for over a quarter of a century. Furthermore, Bloom's Taxonomy offers a framework for evaluation of teacher questions and instructional objectives (Fain & Bader, 1983).

In classroom-related activities, researchers have concluded that teacher questions, test questions, and instructional objectives call for a lower level of thinking (Gall, 1970; Ryan, 1974; Floyd, 1961; Gallagher, 1965; Davis & Tinsley, 1967; Billeh, 1974; Bloom & others, 1956; Bloom,
In other work, Newcomb and Trefz (1987) have developed a modified version of Bloom's Taxonomy. The modified version includes four categories (remembering, processing, creating, and evaluating) as opposed to Bloom's six categories (knowledge, comprehension, application, analysis, synthesis, and evaluation). Aschner (1961) concluded that teacher questions trigger four types of thinking abilities; remembering, reasoning (processing), creative, and evaluating. Aschner's (1961) findings support the Newcomb-Trefz Model.

The training of teachers in the use of a taxonomy to identify cognitive levels shows some promise. Studies by Clegg and others (1967), Farley and Clegg (1969), Gall (1970), Willson (1973), and Kropp and Stoker (1966) concluded that teacher training in questioning behavior and objective setting leads to an increase in the cognitive interaction between students and teacher.

The review of literature related to cognitive development of students indicated that there is a paucity of research regarding vocational education students level of cognitive performance. Specifically, research in determining the level of cognitive performance of production agriculture students enrolled in vocational agriculture programs is lacking. This study was conducted to determine the cognitive levels of instruction in the classroom based upon the courses of study of selected production agriculture
teachers from public schools in Ohio. In addition, this study sought to determine the level of cognition at which students in production agriculture classes were performing.
CHAPTER III

METHODOLOGY

The purpose of this study was to determine at what level of cognition ten selected teachers of production agriculture from secondary schools in Ohio were teaching their vocational agriculture students and to ascertain at what cognitive level the students of the production agriculture teachers selected for this study were performing. The cognitive levels of instruction were identified by evaluating instructional objectives in the individual teacher's course of study. The students' level of cognitive performance was measured by a test developed by the researcher.

This chapter will discuss the research design, population and subject selection, data collection, instrumentation, and the data analysis procedures utilized.

Research Design

Descriptive research was used in this study. To answer the research questions posited in this study, data were obtained by reviewing the courses of study of the production agriculture teachers selected for this study. Teachers of production agriculture were purposefully selected to participate in this study. The twelfth-grade students of
the production agriculture teachers selected for the study were the population for the written examination developed by the researcher.

The production agriculture teachers for this study were purposefully selected by the researcher, teacher educators from the Department of Agricultural Education, The Ohio State University, and State Vocational Agriculture Supervisors from the State Department of Education, Agricultural Education Service. This group of production agriculture teachers were identified as teachers who met or exceeded pre-determined criteria. The selection was made using the broad criteria of facilities, student SOE, course of study, FFA program, and administrative commitment. In addition, the production agriculture teachers selected for this study had been observed and/or supervised by faculty members of the Department of Agricultural Education at The Ohio State University and state supervisors for vocational agriculture in the Ohio Department of Education, Vocational Education Division, Agricultural Education Service.

The study was designed to investigate the following characteristics:

I. Independent Variables
   A. Demographic Characteristics of Teachers
      1. Age
      2. Marital Status
      3. Gender
4. Years Teaching
5. Program Enrollment
6. Educational Attainment
7. Years in Current Position

B. Cognitive Level of Instruction as Indicated by Instructional Objectives in the Course of Study

1. Remembering
2. Processing
3. Creating
4. Evaluating

II. Dependent Variables

A. Level of Student Cognitive Performance on Written Test

1. Remembering
2. Processing
3. Creating
4. Evaluating

This study was designed to control measurement error by ensuring a high inter-rater reliability in the classification of the instructional objectives found in the courses of study. Inter-rater reliability was established by classifying instructional objectives into the proper cognitive levels. The reliability between the researcher, L. H. Newcomb, and M. K. Trefz, who have completed a program of research in this area, was 95%.
Population and Subject Selection

The target population for this study was production agriculture teachers in public secondary schools in Ohio. The students of the production agriculture teachers were the target population for ascertaining the students' level of cognitive performance.

The production agriculture teachers were purposefully selected as the population for the study. The sample size was limited to 10 production agriculture teachers identified by the faculty of the Department of Agricultural Education at The Ohio State University and state supervisors from the Ohio Department of Education, Vocational Education Division, Agricultural Education Service (Appendix E) as having met pre-determined criteria such as facilities, student SOE, FFA program, course of study, and administrative commitment.

The sample size was limited to 10 production agriculture teachers because of the in-depth analysis required of the courses of study, the time and funding limitations placed upon the researcher, and because originally, the researcher was to travel to each of the schools to personally administer the paper-pencil test to the twelfth-grade students.

The students selected for this study were the twelfth-grade students (n=81) enrolled in the vocational agriculture classes taught by the production agriculture teachers who were selected for this study during the 1987-1988 academic
year. All twelfth-grade students were selected to take a test to ascertain their level of cognitive performance.

Data Collection

Data to determine the level of cognition of instruction were collected by means of the researcher carefully reviewing the course of study of each individual production agriculture teacher selected for this study and classifying each instructional objective written in the course of study. At the onset of the study, the researcher mailed a letter to each selected production agriculture teacher detailing the objectives of the study and asking for their cooperation and participation in the study (Appendix F).

The researcher telephoned all selected production agriculture teachers approximately one week after the mailing of the letter to confirm their participation in the study. At this point, once confirmed as participants, the researcher requested the production agriculture teachers to mail their courses of study to the researcher or bring the course of study to The Ohio State University.

Data to determine the demographic characteristics of the production agriculture teachers were collected by the researcher via a questionnaire (Appendix G). These data were collected when the student test was mailed to the selected production agriculture teachers. The demographic questionnaire was returned to the researcher by return mail.
Data to ascertain the level of cognitive performance of the students was collected via a paper-pencil test. The test was administered by the selected production agriculture teachers on May 23, 1988, and May 24, 1988. The researcher mailed the student paper-pencil test to the production agriculture teachers with specific instructions for administration (Appendix H). Once the paper-pencil tests had been administered, the production agriculture teachers mailed the paper-pencil tests to the researcher.

**Instrumentation**

The course of study prepared by each individual production agriculture teacher selected for this study was used to determine the level of cognition of instruction and the percentage of time spent on instruction in each of the five subject areas (leadership, crop production, animal science, agricultural mechanics, and farm management). The courses of study were carefully reviewed page by page by the researcher. During the review of the courses of study, the researcher classified each instructional objective written in each of the courses of study. The instructional objectives were classified into the cognitive levels identified by Newcomb and Trefz (1987). The taxonomy based vocabulary list (Appendix C) was used as a guide for the classification of the instructional objectives. In addition, the researcher categorized the instructional objectives into the appropriate subject area and indicated the required amount
of class days allotted for instruction in each specific subject area.

Reliability on the demographic questionnaire was established for this instrument by comparing selected information supplied by the production agriculture teachers to the same data available from the Ohio State Department of Education, Vocational Education Section, Agricultural Education Service. Through this verification procedure, the information reported by the production agriculture teachers was judged to be reliable.

A paper-pencil test was developed by the researcher which was administered to the twelfth-grade students enrolled in vocational agriculture programs taught by the selected production agriculture teachers. The paper-pencil test was constructed after reviewing the courses of study to ensure that the paper-pencil test questions were related to subject matter which had been part of the students instruction.

The paper-pencil test was developed in four parts, two parts (remembering and processing) consisting of 50 multiple choice questions and two parts (creating and evaluating) consisting of 30 multiple choice questions. Questions for the remembering and processing level were obtained from the Ohio Production Agriculture Achievement Test: Part I and Part II. An assessment of the Achievement Test was conducted and the questions were classified into their respective
level of cognition utilizing the Newcomb-Trefz Model (1987). The results of the assessment indicated that all 350 questions in the Achievement Test were at the remembering or processing level.

Following the assessment of the Achievement Test, the researcher took a randomized proportional sample of questions in each of the five instructional areas (leadership, crop production, animal science, agricultural mechanics, and farm management) in the remembering and processing cognitive levels. The proportion was determined by following the state recommendation of percent of school time to be devoted to instruction in the various instructional areas. The state recommended percentage of instructional time was: leadership, 5%; crop production, 25%; animal science, 25%; agricultural mechanics, 30%; and, farm management 15%.

To select the remembering and processing questions, a random sample of the proportionate number of questions was chosen. The randomization was conducted by assigning a number to each question in each of the cognitive levels and employing the table of random numbers to select the questions. A total of 50 questions were randomly selected for each cognitive level (remembering and processing) through the process of randomization.

Questions at the creating and evaluating level were developed by the researcher. Thirty questions at each cognitive level (creating and evaluating) were written.
The 160 question paper-pencil test (50 remembering level questions, 50 processing level questions, 30 creating level questions, and 30 evaluating level questions) was reviewed for content validity by a panel of teacher educators and former high school vocational agriculture teachers (Appendix I). The 160 question paper-pencil test was pilot tested for reliability and suitability using twelfth-grade production agriculture students from two production agriculture programs which were not selected for this study.

The reliability test using Cronbach's alpha, which is equivalent to Kuder-Richardson 20 by coding the data as dichotomous (SPSS* User's Guide, 1986), produced the following coefficients: remembering questions, Cronbach's alpha = .87; processing questions, Cronbach's alpha = .85; creating questions, Cronbach's alpha = .80; and evaluating questions, Cronbach's alpha = .79. The researcher purposefully selected the 25 questions in each of the cognitive levels (remembering, processing, creating, evaluating) which received the highest item-total correlation score in each respective cognitive level. The 100 question test (25 remembering questions, 25 processing questions, 25 creating questions, and 25 evaluating questions) was again reviewed for content validity by a panel of teacher educators and former high school vocational agriculture teachers (Appendix I). Following the second review for content validity, the researcher conducted another test for reliability using
Cronbach's alpha. The resultant reliability coefficients were: remembering, Cronbach's alpha = .91; processing, Cronbach's alpha = .90; creating, Cronbach's alpha = .84; and, evaluating, Cronbach's alpha = .82.

The paper-pencil test was mailed to the selected production agriculture teachers with specific instructions for administration (Appendix H). The test was administered by the production agriculture teachers to all twelfth-grade students as instructed on May 23, 1988, and May 24, 1988. There was not a specified amount of time allotted to the students to answer the questions on the test.

Upon completion of the paper-pencil test, the selected production agriculture teachers were asked to mail the tests, Test Administration Form (Appendix J), and the Teacher Demographic Questionnaire (Appendix G) by return mail to the researcher.

A copy of the student paper-pencil test is found in Appendix K.

**Data Analysis**

All data were analyzed using the Statistical Package for Social Sciences (SPSS\(^\text{X}\)) at the Instructional and Research Computing Center of The Ohio State University using an alpha level \textit{a priori} of .05.

The first research question sought to describe the production agriculture teachers. The data for research question one were analyzed using descriptive statistics...
consisting of frequencies, percentages, means, and standard deviations.

The second research question sought to describe the subject matter taught by the production agriculture teachers during the 1987-1988 academic year. This information was analyzed using frequencies, percentages, and means.

The third research question sought to determine the cognitive level of instruction utilized by the production agriculture teachers as measured by the Newcomb-Trefz Model. This data was analyzed by using descriptive statistics consisting of frequencies, percentages, and means.

The fourth research question sought to determine the extent to which the cognitive level of instruction differed among the grade levels and subject matter areas. The data for research question four were analyzed by employing a one-way analysis of variance.

The fifth research question sought to determine the extent to which the students of the production agriculture teachers performed at the various levels of cognition based upon a researcher developed paper-pencil test. This data were analyzed by using frequencies, percentages, and means.

The last research question sought to determine if a relationship existed between the level of cognition of instruction and the cognitive performance level of the students. The data for research question six were analyzed by using canonical correlation.
CHAPTER IV
FINDINGS

The purpose of this study was to determine the cognitive level of instruction of selected production agriculture teachers from public schools in Ohio. In addition, this study sought to determine the level of cognition at which students in production agriculture classes were performing. The extent to which a relationship existed between the cognitive level of instruction and the cognitive level of student performance was also studied.

This study was designed to investigate the following characteristics:

I. Antecedents
   A. Demographic Characteristics of Teachers
      1. Age
      2. Marital Status
      3. Gender
      4. Years Teaching
      5. Program Enrollment
      6. Educational Attainment
      7. Years in Current Position
B. Cognitive Level of Instruction

1. Remembering
2. Processing
3. Creating
4. Evaluating

II. Consequence

A. Level of Student Cognitive Performance

1. Remembering
2. Processing
3. Creating
4. Evaluating

The data used in this study came from the selected production agriculture teachers course of study and a paper-pencil test developed by the researcher and administered to all twelfth-grade students of the selected production agriculture teachers.

The following research questions were developed to guide this study.

1. How can the selected production agriculture teachers be described in terms of age, marital status, gender, program enrollment, number of years in the teaching profession, highest educational degree attained, and number of years in their current position?

2. What subject matter was taught by the selected production agriculture teachers during the
1987-1988 academic year as determined by examining their courses of study?

3. What was the cognitive level of instruction utilized by the teachers as measured by the Newcomb-Trefz Model of Cognitive Development based upon the teachers' courses of study?

4. To what extent did the cognitive level of instruction differ among the grade levels (ninth, tenth, eleventh, and twelfth) and subject matter areas as indicated by the teachers' courses of study?

5. To what extent did the students perform at the various levels of cognition based upon a researcher developed written test?

6. What was the relationship between the level of cognition of instruction as measured by the teachers' courses of study and the cognitive performance level of the students?

**Limitations of the Study**

This study was descriptive and relational in nature. Therefore, this study sought to describe and explain the relationship between the level of cognition of instruction and the cognitive performance level of the students. The data utilized in this study were obtained from the courses of study of selected production agriculture teachers and from a researcher-developed paper-pencil test administered to the twelfth-grade students of the selected teachers of
agriculture.

The criteria used to identify the production agriculture teachers and the size of the sample used in this study were identified as limitations. Consequently, the generalizability of the results was limited to the selected production agriculture teachers and their twelfth-grade students.

**Demographic Characteristics of Teachers**

Data were collected related to the age, marital status, gender, number of years in teaching, program enrollment, educational attainment, and years in current position of the production agriculture teachers selected for this study. The analyses reported were based on information provided by the 10 teachers on the Demographic Data Questionnaire (Appendix G). These data are presented in Tables 1 through 5.

**Age**

The overall mean age for the production agriculture teachers was 35.8 years. The majority (60.0 percent) of the production agriculture teachers were age 39 or younger (Table 1).

**Marital Status**

All production agriculture teachers in this study were married.

**Gender**

All production agriculture teachers in this study were male.
### Table 1

**Age of Production Agriculture Teachers**

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>31</td>
<td>3</td>
<td>30.0</td>
</tr>
<tr>
<td>32</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>39</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>40</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>41</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>49</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Mean Age: 35.80

SD: 6.32

**Years of Teaching Experience**

The years of teaching experience are reported in Table 2. The majority (70.0 percent) of the teachers reported
teaching for 15 years or less. The mean number of years of teaching experience was 13.4 years.

Table 2
Years Teaching of Production Agriculture Teachers

<table>
<thead>
<tr>
<th>Years Teaching</th>
<th>n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>30.0</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>20.0</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>20.0</td>
</tr>
<tr>
<td>27</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Mean 13.40
SD 6.43

Program Enrollment
The mean program enrollment reported by the production agriculture teachers was 39.2 students. The majority (70.0
percent) of the teachers reported an enrollment of 40 students or less (Table 3).

### Table 3

**Student Enrollment in Vocational Agriculture Programs**

<table>
<thead>
<tr>
<th>Enrollment</th>
<th>n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>34</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>37</td>
<td>2</td>
<td>20.0</td>
</tr>
<tr>
<td>38</td>
<td>2</td>
<td>20.0</td>
</tr>
<tr>
<td>45</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>50</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>60</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean</th>
<th>39.20</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD</td>
<td>10.38</td>
</tr>
</tbody>
</table>
Educational Attainment

Table 4 shows the data relevant to the educational attainment of the teachers. Fifty percent of the production agriculture teachers had attained a Bachelor of Science degree and 50 percent had attained a Master's degree.

Table 4

Highest Degree Earned by Production Agriculture Teachers

<table>
<thead>
<tr>
<th>Degree</th>
<th>n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Science</td>
<td>5</td>
<td>50.0</td>
</tr>
<tr>
<td>Master's</td>
<td>5</td>
<td>50.0</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Years in Current Position

The mean number of years in the current teaching position was 12.1 years. The majority (70.0 percent) of the production agriculture teachers reported having been in their current teaching position 12 years or less (Table 5).
Table 5

Years in Current Teaching Position of
Production Agriculture Teachers

<table>
<thead>
<tr>
<th>Years</th>
<th>n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>10.0</td>
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<tr>
<td>8</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>20.0</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>20.0</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>24</td>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Mean 12.10
SD 5.34
Subject Matter Taught

Data were collected related to the number of school days devoted to instruction in the selected subject areas as reported in the course of study by the production agriculture teachers.

Table 6 shows that the production agriculture teachers devoted approximately 9 percent of the instructional time to leadership, 16 percent to crop production, 18 percent to animal science, 41 percent to agricultural mechanics, and 17 percent to farm management.

Cognitive Level of Instruction

Data were collected related to the level of cognition of instruction by subject area and grade level as indicated by the teachers' courses of study. These data are presented in Tables 7 through 14.

Distribution of Instructional Objectives Across Levels of Cognition

Thirty-one percent of the instructional objectives were written at the remembering level (Table 7). Approximately 38 percent of the instructional objectives were written at the processing level, 19 percent at the creating level, and 12 percent at the evaluating level.
<table>
<thead>
<tr>
<th>Subject Area</th>
<th>9</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Days</td>
<td>Percent</td>
<td>Days</td>
<td>Percent</td>
<td>Days</td>
<td>Percent</td>
<td>Days</td>
<td>Percent</td>
<td>Days</td>
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<td>Percent</td>
<td>Days</td>
<td>Percent</td>
<td>Days</td>
<td>Percent</td>
</tr>
<tr>
<td>Leadership</td>
<td>26.20</td>
<td>14.55</td>
<td>15.80</td>
<td>8.78</td>
<td>8.80</td>
<td>4.89</td>
<td>13.30</td>
<td>7.39</td>
<td>64.10</td>
<td>8.90</td>
<td>9.60</td>
<td>5.26</td>
<td>0-43</td>
<td>0.24</td>
<td>36-110</td>
<td>5-15</td>
</tr>
<tr>
<td>Crop</td>
<td>28.70</td>
<td>15.94</td>
<td>32.80</td>
<td>18.22</td>
<td>24.50</td>
<td>13.61</td>
<td>27.50</td>
<td>15.28</td>
<td>113.5</td>
<td>15.76</td>
<td>12-40</td>
<td>6-22</td>
<td>0-25</td>
<td>0-14</td>
<td>0-20</td>
<td>0-11</td>
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<tr>
<td>Animal</td>
<td>54.20</td>
<td>30.11</td>
<td>35.40</td>
<td>19.67</td>
<td>24.40</td>
<td>13.56</td>
<td>15.00</td>
<td>8.33</td>
<td>129.0</td>
<td>17.92</td>
<td>9-50</td>
<td>4-39</td>
<td>0-60</td>
<td>0-33</td>
<td>0-59</td>
<td>0-38</td>
</tr>
<tr>
<td>Science</td>
<td>11.54</td>
<td>6.20</td>
<td>17.04</td>
<td>9.35</td>
<td>19.30</td>
<td>11.80</td>
<td>10.54</td>
<td>5.87</td>
<td>39.00</td>
<td>5.41</td>
<td>35-70</td>
<td>19-39</td>
<td>0-60</td>
<td>0-33</td>
<td>0-59</td>
<td>0-38</td>
</tr>
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<td>Agriculture</td>
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<td>28.89</td>
<td>78.60</td>
<td>43.66</td>
<td>96.50</td>
<td>53.61</td>
<td>66.00</td>
<td>36.67</td>
<td>293.10</td>
<td>40.71</td>
<td>9-70</td>
<td>4-39</td>
<td>35-105</td>
<td>19-58</td>
<td>55-155</td>
<td>31-86</td>
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<tr>
<td>Farm Management</td>
<td>18.90</td>
<td>10.51</td>
<td>17.40</td>
<td>9.67</td>
<td>25.80</td>
<td>14.33</td>
<td>58.20</td>
<td>32.33</td>
<td>120.3</td>
<td>16.71</td>
<td>0-43</td>
<td>0-24</td>
<td>0-54</td>
<td>0-30</td>
<td>0-65</td>
<td>0-36</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

aData reported are: Mean, Standard Deviation, Range
### Table 7

#### Distribution of Instructional Objectives Across Levels of Cognition

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Number of Objectives</th>
<th>Percent of Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering</td>
<td>1045</td>
<td>31.00</td>
</tr>
<tr>
<td>Processing</td>
<td>1293</td>
<td>38.36</td>
</tr>
<tr>
<td>Creating</td>
<td>626</td>
<td>18.57</td>
</tr>
<tr>
<td>Evaluating</td>
<td>407</td>
<td>12.07</td>
</tr>
<tr>
<td>Total</td>
<td>3371</td>
<td>100.00</td>
</tr>
</tbody>
</table>

**Distribution of Instructional Objectives Across Levels of Cognition by Subject Area**

Table 8 shows that approximately 16 percent of the instructional objectives were written in the subject area of leadership, 19 percent in crop production, 18 percent in animal science, 30 percent in the subject area of agricultural mechanics, and 17 percent in farm management.
<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Level of Cognition</th>
<th>No.</th>
<th>Percent</th>
<th>No.</th>
<th>Percent</th>
<th>No.</th>
<th>Percent</th>
<th>No.</th>
<th>Percent</th>
<th>No.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remembering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leadership</td>
<td></td>
<td>18.7</td>
<td>33.63</td>
<td>21.0</td>
<td>37.77</td>
<td>11.4</td>
<td>20.50</td>
<td>4.5</td>
<td>7.26</td>
<td>55.6</td>
<td>16.49</td>
</tr>
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<td></td>
<td></td>
<td>6.85</td>
<td>8.77</td>
<td>8.63</td>
<td>8.74</td>
<td>8.77</td>
<td>12.27</td>
<td>4.25</td>
<td>6.33</td>
<td>19.43</td>
<td>5.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-27</td>
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<td>27.55</td>
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<td>0.4</td>
<td>0.18</td>
<td>7-80</td>
<td>7-26</td>
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<td>Crop</td>
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<td>21.8</td>
<td>33.38</td>
<td>26.7</td>
<td>41.14</td>
<td>9.9</td>
<td>15.25</td>
<td>6.5</td>
<td>10.02</td>
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<tr>
<td>Production</td>
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<td>15.35</td>
<td>15.27</td>
<td>10.55</td>
<td>7.25</td>
<td>6.19</td>
<td>9.83</td>
<td>4.03</td>
<td>6.11</td>
<td>26.09</td>
<td>3.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-49</td>
<td>9-52</td>
<td>9-49</td>
<td>33.54</td>
<td>1-21</td>
<td>4.38</td>
<td>2-13</td>
<td>4-20</td>
<td>24-114</td>
<td>13-24</td>
</tr>
<tr>
<td>Animal</td>
<td></td>
<td>18.4</td>
<td>31.13</td>
<td>24.4</td>
<td>41.29</td>
<td>8.6</td>
<td>14.55</td>
<td>7.7</td>
<td>13.03</td>
<td>59.1</td>
<td>17.53</td>
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<tr>
<td>Science</td>
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<td>11.75</td>
<td>13.63</td>
<td>11.25</td>
<td>6.77</td>
<td>5.74</td>
<td>10.25</td>
<td>4.24</td>
<td>7.57</td>
<td>24.70</td>
<td>2.92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-35</td>
<td>2-47</td>
<td>9-49</td>
<td>33.54</td>
<td>1-19</td>
<td>5.39</td>
<td>0-14</td>
<td>0-25</td>
<td>13-106</td>
<td>13-21</td>
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<tr>
<td>Agricultural</td>
<td></td>
<td>29.7</td>
<td>29.67</td>
<td>34.6</td>
<td>34.57</td>
<td>20.8</td>
<td>20.78</td>
<td>15.0</td>
<td>14.98</td>
<td>100.1</td>
<td>29.69</td>
</tr>
<tr>
<td>Mechanics</td>
<td></td>
<td>15.73</td>
<td>13.18</td>
<td>16.47</td>
<td>11.64</td>
<td>13.12</td>
<td>14.12</td>
<td>8.30</td>
<td>6.54</td>
<td>40.36</td>
<td>7.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-45</td>
<td>6-44</td>
<td>8-73</td>
<td>15-60</td>
<td>1-45</td>
<td>2-54</td>
<td>4-25</td>
<td>5-25</td>
<td>42-189</td>
<td>17-42</td>
</tr>
<tr>
<td>Farm</td>
<td></td>
<td>15.9</td>
<td>27.71</td>
<td>22.6</td>
<td>39.37</td>
<td>11.9</td>
<td>20.73</td>
<td>7.0</td>
<td>12.1</td>
<td>57.4</td>
<td>17.03</td>
</tr>
<tr>
<td>Management</td>
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<td>7.74</td>
<td>18.16</td>
<td>10.00</td>
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<td>9.58</td>
<td>11.13</td>
<td>2.75</td>
<td>3.59</td>
<td>20.35</td>
<td>3.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-26</td>
<td>4-67</td>
<td>0-36</td>
<td>0-47</td>
<td>2-31</td>
<td>6-41</td>
<td>3-12</td>
<td>9-20</td>
<td>15-92</td>
<td>12-24</td>
</tr>
</tbody>
</table>

aData reported are: Mean
Standard Deviation
Range
Distribution of Instructional Objectives Across Levels of Cognition by Grade Level

The majority (68 percent to 72 percent) of the instructional objectives written in the courses of study by the production agriculture teachers at all grade levels were written at the lower (remembering and processing) levels of cognition.

Table 9
Percentages of Instructional Objectives Across Levels of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Remembering %</th>
<th>Processing %</th>
<th>Creating %</th>
<th>Evaluating %</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>33.00</td>
<td>39.02</td>
<td>18.28</td>
<td>9.70</td>
</tr>
<tr>
<td>10</td>
<td>30.29</td>
<td>38.48</td>
<td>17.31</td>
<td>13.92</td>
</tr>
<tr>
<td>11</td>
<td>28.87</td>
<td>38.87</td>
<td>19.75</td>
<td>12.51</td>
</tr>
<tr>
<td>12</td>
<td>31.18</td>
<td>37.18</td>
<td>18.88</td>
<td>12.07</td>
</tr>
<tr>
<td>Total</td>
<td>31.00</td>
<td>38.36</td>
<td>18.57</td>
<td>12.07</td>
</tr>
</tbody>
</table>
Distribution of Instructional Objectives Across Levels of Cognition by Grade Level and Subject Area

The data in Tables 10 through 14 indicate that the production agriculture teachers wrote the highest percentage of instructional objectives at the processing level. The next highest percentage of instructional objectives were written at the remembering level. Ranking third in percentage of written instructional objectives was the creating level. The level of cognition which yielded the lowest percentage of written instructional objectives was evaluating.

The distribution of leadership objectives across levels of cognition by grade level is reported on Table 10. The percentage of processing instructional objectives for the subject area of leadership was approximately 38 percent. There was approximately 34 percent of the leadership instructional objectives written at the remembering level. The percentages for the creating and evaluating level were approximately 20 percent and 8 percent respectively.

The distribution of crop production objectives across levels of cognition by grade level is reported on Table 11. Approximately 41 percent of the crop production instructional objectives were written at the processing level. There was approximately 34 percent of the crop production instructional objectives written at the remembering level. The percentages for the creating and evaluating level were
Table 10

Distribution of Leadership Objectives Across Levels of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Grade</th>
<th>Remembering</th>
<th>Processing</th>
<th>Creating</th>
<th>Evaluating</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>9</td>
<td>69</td>
<td>33.17</td>
<td>73</td>
<td>35.10</td>
<td>50</td>
<td>24.04</td>
</tr>
<tr>
<td>10</td>
<td>53</td>
<td>37.86</td>
<td>50</td>
<td>35.71</td>
<td>25</td>
<td>17.86</td>
</tr>
<tr>
<td>11</td>
<td>33</td>
<td>31.43</td>
<td>44</td>
<td>41.91</td>
<td>18</td>
<td>17.14</td>
</tr>
<tr>
<td>12</td>
<td>32</td>
<td>31.07</td>
<td>43</td>
<td>41.75</td>
<td>21</td>
<td>20.38</td>
</tr>
<tr>
<td>Total</td>
<td>187</td>
<td>33.63</td>
<td>210</td>
<td>37.77</td>
<td>114</td>
<td>20.50</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>8.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>556</td>
<td>100.00</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Table 11

Distribution of Crop Production Objectives Across Levels of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Remembering</th>
<th>Processing</th>
<th>Creating</th>
<th>Evaluating</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>9</td>
<td>66</td>
<td>33.50</td>
<td>89</td>
<td>45.18</td>
<td>28</td>
</tr>
<tr>
<td>10</td>
<td>48</td>
<td>26.97</td>
<td>88</td>
<td>49.44</td>
<td>23</td>
</tr>
<tr>
<td>11</td>
<td>49</td>
<td>33.56</td>
<td>48</td>
<td>32.88</td>
<td>30</td>
</tr>
<tr>
<td>12</td>
<td>55</td>
<td>42.97</td>
<td>42</td>
<td>32.81</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>218</td>
<td>33.59</td>
<td>267</td>
<td>41.14</td>
<td>99</td>
</tr>
</tbody>
</table>
approximately 15 percent and 10 percent respectively.

The distribution of animal science objectives across levels of cognition by grade level is indicated in Table 12. Approximately 31 percent of the instructional objectives were written at the remembering level, 41 percent at the processing level, 15 percent at the creating level, and 13 percent at the evaluating level.

The distribution of agricultural mechanics objectives across levels of cognition by grade level is shown in Table 13. The production agriculture teachers wrote approximately 31 percent of the instructional objectives for agricultural mechanics at the remembering level, 35 percent at the processing level, 21 percent at the creating level, and 15 percent of the agricultural mechanics instructional objectives were written at the evaluating level.

The distribution of farm management objectives across levels of cognition by grade level is reported in Table 14. Approximately 28 percent of the farm management objectives were written at the remembering level. In addition, the processing level instructional objectives for farm management was approximately 39 percent, 21 percent creating, and 12 percent evaluating.

**Differences in Levels of Cognition of Instruction by Grade Level and Subject Area**

The instructional objectives written by the production agriculture teachers were classified by cognitive level,
Table 12

Distribution of Animal Science Objectives Across Levels of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Remembering</th>
<th>Processing</th>
<th>Creating</th>
<th>Evaluating</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>9</td>
<td>59</td>
<td>30.26</td>
<td>89</td>
<td>45.64</td>
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<tr>
<td>10</td>
<td>61</td>
<td>35.88</td>
<td>70</td>
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<td>14</td>
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<tr>
<td>11</td>
<td>29</td>
<td>21.17</td>
<td>57</td>
<td>41.61</td>
<td>31</td>
</tr>
<tr>
<td>12</td>
<td>35</td>
<td>39.33</td>
<td>28</td>
<td>31.46</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>184</td>
<td>31.13</td>
<td>244</td>
<td>41.29</td>
<td>86</td>
</tr>
</tbody>
</table>
Table 13

Distribution of Agricultural Mechanics Objectives Across Levels of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Remembering</th>
<th>Processing</th>
<th>Creating</th>
<th>Evaluating</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>9</td>
<td>60</td>
<td>35.09</td>
<td>54</td>
<td>31.58</td>
<td>33</td>
</tr>
<tr>
<td>10</td>
<td>70</td>
<td>27.14</td>
<td>81</td>
<td>31.39</td>
<td>61</td>
</tr>
<tr>
<td>11</td>
<td>97</td>
<td>30.03</td>
<td>121</td>
<td>37.46</td>
<td>62</td>
</tr>
<tr>
<td>12</td>
<td>70</td>
<td>28.12</td>
<td>90</td>
<td>36.14</td>
<td>52</td>
</tr>
<tr>
<td>Total</td>
<td>297</td>
<td>29.67</td>
<td>346</td>
<td>34.56</td>
<td>208</td>
</tr>
</tbody>
</table>
Table 14

Distribution of Farm Management Objectives Across Levels of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Remembering</th>
<th>Processing</th>
<th>Creating</th>
<th>Evaluating</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>41 (34.75%)</td>
<td>38 (32.20%)</td>
<td>26 (22.03%)</td>
<td>13 (11.02%)</td>
<td>118 (20.56%)</td>
</tr>
<tr>
<td>10</td>
<td>27 (24.76%)</td>
<td>40 (36.70%)</td>
<td>25 (22.94%)</td>
<td>17 (15.60%)</td>
<td>109 (18.98%)</td>
</tr>
<tr>
<td>11</td>
<td>23 (25.84%)</td>
<td>41 (46.07%)</td>
<td>17 (19.10%)</td>
<td>8 (8.99%)</td>
<td>89 (15.51%)</td>
</tr>
<tr>
<td>12</td>
<td>68 (26.36%)</td>
<td>107 (41.47%)</td>
<td>51 (19.77%)</td>
<td>32 (12.40%)</td>
<td>258 (44.95%)</td>
</tr>
</tbody>
</table>

Total 159 (27.71%) 226 (39.37%) 119 (20.73%) 70 (12.19%) 574 (100.00%)
subject area, and grade level. Research question 4 sought to determine the extent to which the cognitive level of instruction differed among the grade levels and subject matter areas as indicated by the production agriculture teachers' courses of study.

The null hypothesis tested was that the average percent of instructional objectives among the grade levels within each cognitive level and subject area was equal. This test was conducted by using one-way analysis of variance (ANOVA). In cases where there was a significant difference noted among the average percents, the Tukey-HSD post-hoc analysis test was utilized.

Leadership Instructional Objectives at the Remembering Level of Cognition

Table 15 shows that at the ninth-grade level, the average percent was 25.11, tenth-grade average percent was 26.44, eleventh-grade average percent was 23.34, and the twelfth-grade average percent was 17.72, for the leadership instructional objectives written at the remembering cognitive level by the teachers.

Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted between the grade levels.
### Table 15

**Analysis of Variance of Percentage of Leadership Instructional Objectives for the Remembering Level of Cognition by Grade Level**

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>25.11(^a)</td>
<td>26.44(^a)</td>
<td>23.34(^a)</td>
<td>15.72(^a)</td>
</tr>
<tr>
<td>SD</td>
<td>14.65</td>
<td>23.61</td>
<td>27.27</td>
<td>18.89</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>6.89</td>
<td>2.30</td>
<td>.49</td>
<td>.69</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>168.51</td>
<td>4.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>175.40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.

**Crop Production Instructional Objectives at the Remembering Level of Cognition**

Table 16 shows that at the ninth-grade level, the average percent was 23.28, tenth-grade average percent was 20.77, eleventh-grade average percent was 15.52, and the twelfth-grade average percent was 16.24.
Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences between the grade levels.

Table 16

Analysis of Variance of Percentage of Crop Production

Instructional Objectives for the Remembering Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>23.28a</td>
<td>20.77a</td>
<td>15.52a</td>
<td>16.24a</td>
</tr>
<tr>
<td>SD</td>
<td>7.65</td>
<td>16.38</td>
<td>13.52</td>
<td>12.35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
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<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>4.12</td>
<td>1.37</td>
<td>.83</td>
<td>.49</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>59.57</td>
<td>1.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>63.69</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.

Animal Science Instructional Objectives at the Remembering Level of Cognition

Table 17 shows that at the ninth-grade level, the average percent was 19.39, tenth-grade average percent was
20.72, eleventh-grade average percent was 10.68, and the twelfth-grade average percent was 10.84.

Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted between the grade levels.

Table 17

Analysis of Variance of Percentage of Animal Science Instructional Objectives for the Remembering Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>n</th>
<th>Mean*</th>
<th>SD</th>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ninth-Grade</td>
<td>10</td>
<td>19.39a</td>
<td>8.10</td>
<td>Between Groups</td>
<td>3</td>
<td>8.73</td>
<td>2.91</td>
<td>3.12</td>
<td>.06</td>
</tr>
<tr>
<td>Tenth-Grade</td>
<td>10</td>
<td>20.72a</td>
<td>12.25</td>
<td>Within Groups</td>
<td>36</td>
<td>33.54</td>
<td>.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eleventh-Grade</td>
<td>10</td>
<td>10.68a</td>
<td>10.41</td>
<td>Total</td>
<td>39</td>
<td>42.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twelfth-Grade</td>
<td>10</td>
<td>10.84a</td>
<td>6.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Agricultural Mechanics Instructional Objectives at the Remembering Level of Cognition

Table 18 shows that for the ninth-grade level, the average percent was 18.42, the tenth-grade average percent was 23.89, eleventh-grade average percent was 41.38, and the twelfth-grade average percent was 25.05.

Using one-way ANOVA, the null hypothesis was not accepted at \( \alpha = .05 \). The average percents in the population are not equal. The Tukey-HSD post-hoc analysis procedure revealed a significant difference \( (\alpha = .05) \) between the ninth-grade level and the eleventh-grade level and between the tenth-grade level and the eleventh-grade level. Thus, it is inferred that in the population, at the cognitive level of remembering, in the subject area of agricultural mechanics, the teachers write significantly more remembering level instructional objectives at the eleventh-grade level that at the ninth- and tenth-grade levels.

Farm Management Instructional Objectives at the Remembering Level of Cognition

Table 19 shows that for the ninth-grade level, the average percent was 13.80. The tenth-grade average percent was 8.18, eleventh-grade average percent was 9.07, and the twelfth-grade average percent was 32.15.

Using one-way ANOVA, the null hypothesis was not accepted at \( \alpha = .05 \). The means in the population were
Table 18
Analysis of Variance of Percentage of Agricultural Mechanics Instructional Objectives for the Remembering Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>18.42\text{a}</td>
<td>23.89\text{a}</td>
<td>41.38\text{b}</td>
<td>25.05\text{a}\text{b}</td>
</tr>
<tr>
<td>SD</td>
<td>8.98</td>
<td>7.37</td>
<td>20.26</td>
<td>17.06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
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<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>29.39</td>
<td>9.80</td>
<td>4.68</td>
<td>.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>75.29</td>
<td>2.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>104.68</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.

not equal. The Tukey-HSD post-hoc analysis test revealed a significant difference (\( \alpha = .05 \)) between the twelfth-grade level and the ninth-grade level, between the twelfth-grade level and the tenth-grade level, and between the twelfth-grade level and eleventh-grade level. Therefore, in the population, it may be inferred, that the teachers write significantly more remembering level instructional
objectives at the twelfth-grade level than at the ninth-, tenth-, and eleventh-grade levels in the farm management subject area.

Table 19
Analysis of Variance of Percentage of Farm Management Instructional Objectives for the Remembering Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>n</th>
<th>Mean*</th>
<th>SD</th>
<th>9th-Grade</th>
<th>10th-Grade</th>
<th>11th-Grade</th>
<th>12th-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ninth-Grade</td>
<td>10</td>
<td>13.80a</td>
<td>4.32</td>
<td>13.80</td>
<td>8.18a</td>
<td>9.07a</td>
<td>32.15b</td>
</tr>
<tr>
<td>Tenth-Grade</td>
<td>10</td>
<td>8.18a</td>
<td>9.45</td>
<td>8.18</td>
<td>9.07a</td>
<td>8.62</td>
<td>21.73</td>
</tr>
<tr>
<td>Eleventh-Grade</td>
<td>10</td>
<td>9.07a</td>
<td>8.62</td>
<td>9.07a</td>
<td>8.62</td>
<td>21.73</td>
<td></td>
</tr>
<tr>
<td>Twelfth-Grade</td>
<td>10</td>
<td>32.15b</td>
<td>21.73</td>
<td>32.15b</td>
<td>21.73</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>37.46</td>
<td>12.49</td>
<td>6.54</td>
<td>.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>68.74</td>
<td>1.91</td>
<td>1.91</td>
<td>1.91</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>106.20</td>
<td>106.20</td>
<td>106.20</td>
<td>106.20</td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.

Leadership Instructional Objectives at the Processing Level of Cognition

Table 20 shows that at the ninth-grade level, the average percent was 20.59, tenth-grade average percent was
15.09, eleventh-grade average percent was 14.16, and the twelfth-grade average percent was 13.15.

Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted between the grade levels.

Table 20

Analysis of Variance of Percentage of Leadership Instructional Objectives for the Processing Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>20.59a</td>
<td>15.09a</td>
<td>14.16a</td>
<td>13.15a</td>
</tr>
<tr>
<td>SD</td>
<td>6.34</td>
<td>10.63</td>
<td>8.67</td>
<td>9.12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>3.31</td>
<td>1.10</td>
<td>1.42</td>
<td>.25</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>28.03</td>
<td>.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>31.34</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Crop Production Instructional Objectives at the Processing Level of Cognition

Table 21 shows that for the ninth-grade level, the average percent was 24.95, tenth-grade average percent was 30.01, eleventh-grade average percent was 14.20, and the twelfth-grade average percent was 11.45.

Table 21
Analysis of Variance of Percentage of Crop Production Instructional Objectives for the Processing Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>24.95ab</td>
<td>30.01a</td>
<td>14.20b</td>
<td>11.45b</td>
</tr>
<tr>
<td>SD</td>
<td>8.40</td>
<td>11.02</td>
<td>9.60</td>
<td>8.61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
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<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>23.14</td>
<td>7.71</td>
<td>8.61</td>
<td>.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>32.23</td>
<td>.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>55.37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Using one-way ANOVA, the null hypothesis was not accepted at $\alpha = .05$. The means in the population were not equal. The Tukey-HSD post-hoc analysis procedure revealed a significant difference between the tenth-grade level and eleventh-grade level and between the tenth-grade and twelfth-grade levels. It may be inferred therefore, that in the population, in the subject area of crop production, the teachers write significantly more processing level instructional objectives at the tenth-grade level than at the eleventh- and twelfth-grade levels.

**Animal Science Instructional Objectives at the Processing Level of Cognition**

Table 22 shows that for the ninth-grade level, the average percent was 25.58, tenth-grade average percent was 19.03, eleventh-grade average percent was 17.60, and the twelfth-grade average percent was 8.50.

Using one-way ANOVA, the null hypothesis was not accepted at $\alpha = .05$. The average percents in the population are not equal. The Tukey-HSD post-hoc analysis procedure revealed a significant difference ($\alpha = .05$) between the ninth-grade level and the twelfth-grade level. Thus it is inferred that in the population, at the cognitive level of processing, in the subject area of animal science, the teachers write significantly more processing level instructional objectives at the ninth-grade level than at the twelfth-grade level.
Table 22

Analysis of Variance of Percentage of Animal Science
Instructional Objectives for the Processing Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>25.58&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>17.60&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>8.50&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>SD</td>
<td>8.15</td>
<td>9.62</td>
<td>14.76</td>
<td>6.32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
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<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>14.85</td>
<td>4.95</td>
<td>4.75</td>
<td>.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>37.52</td>
<td>1.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>52.37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Agricultural Mechanics Instructional Objectives at the Processing Level of Cognition

Table 23 shows that for the ninth-grade level, the average percent was 15.73. The tenth-grade average percent was 21.73 and the eleventh-grade average percent was 40.09. The twelfth-grade average percent was 28.78.

Using one-way ANOVA, the null hypothesis was not accepted at $\alpha = .05$. The average percents in the population were not equal. The Tukey-HSD post-hoc analysis test revealed a significant difference ($\alpha = .05$) between the ninth-grade level and the eleventh-grade level. It may be inferred therefore, that in the population, in the subject area of agricultural mechanics, the teachers write significantly more processing level instructional objectives at the eleventh-grade level than at the ninth-grade level.

Farm Management Instructional Objectives at the Processing Level of Cognition

Table 24 shows that for the ninth-grade level, the average percent was 13.16, tenth-grade average percent was 14.14, eleventh-grade average percent was 13.95 and, the twelfth-grade average percent was 38.12.

Using one-way ANOVA, the null hypothesis was not accepted at $\alpha = .05$. The means in the population were not equal. The Tukey-HSD post-hoc analysis test revealed a significant difference ($\alpha = .05$) between the twelfth-grade level and the ninth-, tenth-, and eleventh-grade levels. In
the subject area of farm management, in the population, it may be inferred that the teachers write significantly more processing instructional objectives at the twelfth-grade level than at the ninth-, tenth-, and eleventh-grade levels.

Table 23
Analysis of Variance of Percentage of Agricultural Mechanics Instructional Objectives for the Processing Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>15.73a</td>
<td>21.73ab</td>
<td>40.09b</td>
<td>28.78ab</td>
</tr>
<tr>
<td>SD</td>
<td>9.71</td>
<td>13.08</td>
<td>21.31</td>
<td>15.05</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Source</th>
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<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>32.85</td>
<td>10.95</td>
<td>4.63</td>
<td>.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>85.13</td>
<td>2.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>117.98</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Table 24

Analysis of Variance of Percentage of Farm Management Instructional Objectives for the Processing Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>13.16a</td>
<td>14.14a</td>
<td>13.95a</td>
<td>38.12b</td>
</tr>
<tr>
<td>SD</td>
<td>8.25</td>
<td>8.20</td>
<td>9.07</td>
<td>20.91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>44.61</td>
<td>14.87</td>
<td>9.08</td>
<td>.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>58.93</td>
<td>1.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>103.54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.

Leadership Instructional Objectives at the Creating Level of Cognition

Table 25 shows that for the ninth-grade level, the average percent was 25.82. The tenth-grade average percent was 16.84, eleventh-grade average percent was 10.47, and the
twelfth-grade average percent was 13.56.

Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted between the grade levels.

Table 25
Analysis of Variance of Percentage of Leadership Instructional Objectives for the Creating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>25.82a</td>
<td>16.84a</td>
<td>10.47a</td>
<td>13.56a</td>
</tr>
<tr>
<td>SD</td>
<td>16.18</td>
<td>16.74</td>
<td>6.94</td>
<td>11.10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>12.80</td>
<td>4.27</td>
<td>2.34</td>
<td>.09</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>63.72</td>
<td>1.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>76.52</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Crop Production Instructional Objectives at the Creating Level of Cognition

Table 26 shows that at the ninth-grade level, the average percent was 17.11, tenth-grade average percent was 15.38, eleventh-grade average percent was 17.82, and the twelfth-grade average percent was 16.35.

Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted between the grade levels.

Animal Science Instructional Objectives at the Creating Level of Cognition

Table 27 shows that for the ninth-grade level, the average percent was 15.61, tenth-grade average percent was 9.54, eleventh-grade average percent was 21.48, and the twelfth-grade average percent was 8.59.

Using one-way ANOVA, the null hypothesis was not accepted at $\alpha = .05$. The average percents in the population were not equal. The Tukey-HSD post-hoc analysis test revealed a significant difference ($\alpha = .05$) between the eleventh-grade level and the twelfth-grade level. In the subject area of animal science, in the population, it may be inferred that the teachers write significantly more creating instructional objectives at the eleventh-grade level than at the twelfth-grade level.
Table 26

Analysis of Variance of Percentage of Crop Production

Instructional Objectives for the Creating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>17.11a</td>
<td>15.38a</td>
<td>17.82a</td>
<td>16.35a</td>
</tr>
<tr>
<td>SD</td>
<td>13.80</td>
<td>12.63</td>
<td>14.77</td>
<td>15.69</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>.33</td>
<td>.11</td>
<td>.05</td>
<td>.98</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>71.09</td>
<td>2.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>71.42</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Table 27
Analysis of Variance of Percentage of Animal Science Instructional Objectives for the Creating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>15.61&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>9.54&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>21.48&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.59&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>SD</td>
<td>8.71</td>
<td>8.35</td>
<td>14.04</td>
<td>6.78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>10.15</td>
<td>3.38</td>
<td>3.59</td>
<td>.02</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>33.03</td>
<td>.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>43.18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.

Agricultural Mechanics Instructional Objectives at the Creating Level of Cognition

Table 28 shows that for the ninth-grade level, the average percent was 24.03, tenth-grade average percent was 33.49, eleventh-grade average percent was 38.47, and the twelfth-grade average percent was 32.81.
Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted between the grade levels.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>54.20</td>
<td>18.07</td>
<td>.88</td>
<td>.47</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>758.20</td>
<td>21.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>812.40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Farm Management Instructional Objectives at the Creating Level of Cognition

Table 29 shows that for the ninth-grade level, the average percent was 17.43, tenth-grade average percent was 24.79, eleventh-grade average percent was 11.76, the twelfth-grade average percent was 28.70.

Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted between the grade levels.

Leadership Instructional Objectives at the Evaluating Level of Cognition

Table 30 shows that for the ninth-grade level, the average percent was 15.58, tenth-grade average percent was 7.86, eleventh-grade average percent was 9.43 and, the twelfth-grade average percent 7.29.

Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted between the grade levels.

Crop Production Instructional Objectives at the Evaluating Level of Cognition

Table 31 shows that for the ninth-grade level, the average percent was 15.38, tenth-grade average percent was 16.09, eleventh-grade average percent was 19.44, and the twelfth-grade average percent 13.43.

Using one-way ANOVA, the null hypothesis was accepted at $\alpha = .05$. There were no significant differences noted
between the grade levels.

Table 29

Analysis of Variance of Percentage of Farm Management Instructional Objectives for the Creating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th>n</th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>17.43&lt;sup&gt;a&lt;/sup&gt;</td>
<td>24.79&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.76&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.70&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>SD</td>
<td>10.03</td>
<td>27.51</td>
<td>9.81</td>
<td>18.97</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>16.31</td>
<td>5.44</td>
<td>1.62</td>
<td>.20</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>117.27</td>
<td>3.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>133.58</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Mean with the same superscript do not differ significantly when alpha = .05.
Table 30
Analysis of Variance of Percentage of Leadership Instructional Objectives for the Evaluating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>n</th>
<th>Mean*</th>
<th>SD</th>
<th>Mean*</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ninth-Grade</td>
<td>10</td>
<td>15.58a</td>
<td>13.08</td>
<td>7.86a</td>
<td>9.19</td>
</tr>
<tr>
<td>Tenth-Grade</td>
<td>10</td>
<td>9.43a</td>
<td>7.85</td>
<td>7.29a</td>
<td>14.38</td>
</tr>
<tr>
<td>Eleventh-Grade</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twelfth-Grade</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>4.38</td>
<td>1.44</td>
<td>1.09</td>
<td>.37</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>46.54</td>
<td>1.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>50.87</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Table 31

Analysis of Variance of Percentage of Crop Production

Instructional Objectives for the Evaluating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>n</th>
<th>Mean*</th>
<th>SD</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ninth-Grade</td>
<td>10</td>
<td>15.38a</td>
<td>11.86</td>
<td>16.09a</td>
<td>19.44a</td>
<td>13.43a</td>
</tr>
<tr>
<td>Tenth-Grade</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eleventh-Grade</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twelfth-Grade</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>1.76</td>
<td>.59</td>
<td>.37</td>
<td>.77</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>55.24</td>
<td>1.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>57.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Animal Science Instructional Objectives at the Evaluating Level of Cognition

Table 32 shows that for the ninth-grade level, the average percent was 23.82, tenth-grade average percent was 21.55, eleventh-grade average percent was 17.72, and the twelfth-grade average percent 10.84.

Using one-way ANOVA, the null hypothesis was accepted at \( \alpha = .05 \). There were no significant differences noted between the grade levels.

Agricultural Mechanics Instructional Objectives at the Evaluating Level of Cognition

Table 33 shows that for the ninth-grade level, the average percent was 26.79, tenth-grade average percent was 41.51, eleventh-grade average percent was 43.30, the twelfth-grade average percent was 34.77.

Using one-way ANOVA, the null hypothesis was accepted at \( \alpha = .05 \). There were no significant differences noted between the grade levels.

Farm Management Instructional Objectives at the Evaluating Level of Cognition

Table 34 shows that for the ninth-grade level, the average percent was 18.43, tenth-grade average percent was 12.99, eleventh-grade average percent was 10.11, and the twelfth-grade average percent was 33.67.

Using one-way ANOVA, the null hypothesis was not accepted at \( \alpha = .05 \). The average percents in the
Table 32

Analysis of Variance of Percentage of Animal Science Instructional Objectives for the Evaluating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>23.82a</td>
<td>21.55a</td>
<td>17.72a</td>
<td>10.84a</td>
</tr>
<tr>
<td>SD</td>
<td>16.76</td>
<td>13.51</td>
<td>14.52</td>
<td>9.52</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>9.69</td>
<td>3.23</td>
<td>1.69</td>
<td>.19</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>66.74</td>
<td>1.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>76.43</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
Table 33
Analysis of Variance of Percentage of Agricultural Mechanics Instructional Objectives for the Evaluating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>26.79\textsuperscript{a}</td>
<td>41.51\textsuperscript{a}</td>
<td>43.30\textsuperscript{a}</td>
<td>34.77\textsuperscript{a}</td>
</tr>
<tr>
<td>SD</td>
<td>20.50</td>
<td>14.84</td>
<td>28.80</td>
<td>9.43</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>16.40</td>
<td>5.47</td>
<td>1.45</td>
<td>.25</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>131.98</td>
<td>3.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>168.38</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.

population were not equal. The Tukey-HSD post-hoc analysis procedure revealed a significant difference (\( \alpha = .05 \)) between the twelfth-grade level and the tenth-grade level and between the twelfth-grade level and eleventh-grade level. Thus, it is inferred that in the population, at the cognitive level of evaluating, in the subject area of farm management, the teachers write significantly more evaluating
level instructional objectives at the twelfth-grade level than at the tenth- and eleventh-grade levels.

Analysis of Variance Summary

Two out of the 5 subject areas in the remembering level of cognition were found to have significant differences by grade level. The subject areas which were statistically significant were agricultural mechanics and farm management. In the subject area of agricultural mechanics, the teachers were writing significantly more instructional objectives at the eleventh-grade level than at the ninth-grade level at the remembering level of cognition. In the subject area of farm management, at the remembering level of cognition, the teachers were writing significantly more instructional objectives at the twelfth-grade level than at the ninth-, tenth-, and eleventh-grade levels.

At the cognitive level of processing, in four of the five subject areas, significant differences were found. The subject areas which had significant differences were crop production, animal science, agricultural mechanics, and farm management. In the subject area of crop production, the teachers were writing significantly more instructional objectives at the tenth-grade level than at the eleventh- or twelfth-grade levels at the processing level of cognition. Animal science instructional objectives at the processing level of cognition, were found to be significantly more at the ninth-grade level than at the twelfth-grade level. In
the subject area of agricultural mechanics, significantly more instructional objectives were written at the eleventh-grade level than at the ninth-grade level at the processing level of cognition. Finally, in the subject area of farm management, at the processing level of cognition, the teachers wrote significantly more instructional objectives at the twelfth-grade level than at the ninth-, tenth-, or eleventh-grade levels.

Only one subject area was found to have significant differences at the creating level of cognition. The subject area was animal science where significantly more instructional objectives were written at the eleventh-grade level than at the twelfth-grade level at the creating level of cognition.

Likewise, at the evaluating cognitive level, only one subject area was found to have a significant difference. The teachers wrote significantly more instructional objectives at the twelfth-grade level than at the tenth- or eleventh-grade levels in the subject area of farm management at the evaluating level of cognition.

In summary, agricultural mechanics had significant differences at the remembering and processing levels of cognition. Farm management had significant differences at the remembering, processing, and evaluating levels of cognition. The subject area of crop production had a significant difference at the processing level of cognition.
Animal science had significant differences at the levels of cognition of processing and creating.

Table 34

Analysis of Variance of Percentage of Farm Management Instructional Objectives for the Evaluating Level of Cognition by Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Ninth-Grade</th>
<th>Tenth-Grade</th>
<th>Eleventh-Grade</th>
<th>Twelfth-Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mean*</td>
<td>18.43ab</td>
<td>12.99a</td>
<td>10.11a</td>
<td>33.67b</td>
</tr>
<tr>
<td>SD</td>
<td>17.06</td>
<td>12.20</td>
<td>10.84</td>
<td>18.49</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>32.26</td>
<td>10.75</td>
<td>4.72</td>
<td>.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>36</td>
<td>79.77</td>
<td>2.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>112.03</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with the same superscript do not differ significantly when alpha = .05.
**Student Performance**

Data were collected related to the level of cognition of student performance via a paper-pencil test administered to the twelfth-grade students of the selected production agriculture teachers. These data are presented in Table 35.

The mean score of correctly answered questions at each level of cognition was recorded. Students answered correctly approximately 64 percent of the remembering level questions, 55 percent of the processing level questions, 40 percent of the creating level questions, and 28 percent of the evaluating level questions.

**Table 35**

**Distribution of Student Mean Scores Across Level of Cognition**

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Mean Score (Percent Items Correct)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering</td>
<td>63.91</td>
</tr>
<tr>
<td>Processing</td>
<td>55.41</td>
</tr>
<tr>
<td>Creating</td>
<td>40.02</td>
</tr>
<tr>
<td>Evaluating</td>
<td>28.20</td>
</tr>
</tbody>
</table>
Relationship Between Level of Cognition of Instruction and Student Level of Cognitive Performance

The magnitude of the relationship investigated in this study was described based on the scale delineated by Davis (1971).

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

Correlation coefficients were computed for the relationship between the independent and dependent variables. The independent variable for this study was the level of cognition of instructional objectives written by the production agriculture teachers (measured in percent of instructional objectives written). The dependent variable was the cognitive level of student performance (measured in percent correct answers) on a paper-pencil test.

Canonical correlation was used as the procedure for investigating the relationship between the two variable sets. For this study, the two sets of variables were: 1) criterion variables (or the formerly labeled dependent variables), and, 2) predictor variables (or the independent variables).
**Canonical Correlation Overview**

Canonical correlation analysis collapses the scores for each case on each variable in each variable set into a single composite score. The composite scores derived are called variate scores. Thereafter, two linear combinations of composite scores (variates) are formed to obtain the maximum correlation possible between the two variable sets. The number of pairs of canonical variates generated equals the smaller number of variables in either the predictor variable set or the criterion variable set.

Canonical correlations can be calculated once the canonical variates have been created. For each pair of variates, a canonical correlation coefficient is calculated. This statistic portrays the magnitude of the relationship between a pair of canonical variates. A squared canonical correlation coefficient provides an estimate of the shared variance between the pair of canonical variates.

The null hypothesis tested was that all squared canonical correlation coefficients equal zero ($R_0^2(s)=0$). Conducting a test of significance for the canonical functions is accomplished by utilizing Wilks Lambda.

The next step is to calculate the redundancy index. The redundancy index indicates the ability of a set of predictor variables to explain variation in the criterion set. This statistic is analogous to $R^2$ in multiple regression.
The final step is to interpret the relationships which exist between the two sets of variables. Canonical structure coefficients help to achieve this objective by depicting the relative contribution of each variable to the canonical relationship.

Table 36 through Table 41 show the results of the canonical correlation.

Descriptive Summary

The distribution of instructional objectives written by the production agriculture teachers in average percentages were: remembering, 31.00; processing, 38.36; creating, 18.57; and evaluating, 12.07. The distribution of the student average percentages across the levels of cognition were: remembering, 63.91; processing, 55.41; creating, 40.02; and, evaluating, 28.20 (Table 36).

Correlation Between Teacher Level of Cognitive Instruction and Student Level of Cognitive Performance

The relationship between the teachers level of cognitive instruction and student level of cognitive performance was calculated using Pearson's Product Moment Correlation. Table 37 shows the correlation matrix depicting the relationship between the independent and the dependent variables.

Table 37 shows that for the criterion variable set, remembering correlates only with creating, but negatively.
Table 36
Descriptive Statistics

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Teacher Percent</th>
<th>Teacher Number</th>
<th>Student Percent</th>
<th>Student Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering</td>
<td>31.00</td>
<td>1045</td>
<td>63.91</td>
<td>81</td>
</tr>
<tr>
<td>Processing</td>
<td>38.36</td>
<td>1293</td>
<td>55.41</td>
<td>81</td>
</tr>
<tr>
<td>Creating</td>
<td>18.57</td>
<td>626</td>
<td>40.02</td>
<td>81</td>
</tr>
<tr>
<td>Evaluating</td>
<td>12.07</td>
<td>407</td>
<td>28.20</td>
<td>81</td>
</tr>
</tbody>
</table>

Processing does not correlate with any of the other variables in the criterion variable set. Creating correlates somewhat with processing (negatively) and with evaluating (positively). Evaluating correlates only with creating.

Among the predictor variable set, Table 37 indicates relatively high and positive intercorrelations. The correlation is high between remembering and processing, and between creating and evaluating. Substantial correlations between processing and both creating and evaluating exists. Low correlations between remembering and both creating and evaluating are evident.
Table 37
Relationship* Between Teachers Level of Cognitive Instruction and Students Level of Cognitive Performance (n=81)

<table>
<thead>
<tr>
<th></th>
<th>Criterion Variable Set (Percent Items Correct)</th>
<th>Predictor Variable Set (Percent of Instructional Objectives)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Student Level of Cognitive Performance</td>
<td>Teacher Level of Cognitive Instruction</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>P</td>
</tr>
<tr>
<td>Criterion Variable Set</td>
<td>Student Remembering</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Student Processing</td>
<td>.058</td>
</tr>
<tr>
<td></td>
<td>Student Creating</td>
<td>-.234</td>
</tr>
<tr>
<td></td>
<td>Student Evaluating</td>
<td>-.003</td>
</tr>
<tr>
<td></td>
<td>Predictor Variable Set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher Remembering</td>
<td>.115</td>
</tr>
<tr>
<td></td>
<td>Teacher Processing</td>
<td>.194</td>
</tr>
<tr>
<td></td>
<td>Teacher Creating</td>
<td>.272</td>
</tr>
<tr>
<td></td>
<td>Teacher Evaluating</td>
<td>.292</td>
</tr>
</tbody>
</table>

Note: R=Remembering; P=Processing; C=Creating; E=Evaluating
*Pearson's Product Moment Correlation Coefficients
The correlation between the individual predictor and individual criterion variables indicates that 10 out of 16 coefficients are negative. The coefficients range from negligible to moderate. Table 37 shows that of the direct pairs (teacher remembering versus student remembering, teacher processing versus student processing, teacher creating versus student creating, and teacher evaluating versus student evaluating), 2 out of 4 are negative (creating and evaluating) and only one pair (creating) is moderate but negative.

Table 38 shows that four functions (four pairs of variates) were derived. The first function yielded a canonical correlation of .557, squared canonical correlation of .312, and an Eigen value of .453. The correlation obtained from the second function was .178, squared canonical correlation of .032, and an Eigen value of .033. The third function yielded a correlation coefficient of .092, squared canonical correlation of .008, and an Eigen value of .009. The final function (Function 4) yielded a correlation coefficient of .071, squared canonical correlation of .005, and an Eigen value of .005.

The null hypothesis tested was that all squared canonical correlations ($R^2_0(s)$) equal zero. The analysis yielded a Wilks Lambda of .657 with an F statistic of 2.059, with 6, 224 degrees of freedom. This test was significant at $p=.01$. The null hypothesis was rejected, thus the first
squared canonical correlation ($R^2(1)$) is statistically significant. Following the ten percent rule of thumb, the remaining squared canonical correlation coefficients ($R^2(2)=.032; R^2(3)=.008; \text{ and } R^2(4)=.005$) are less than .10 and will not be considered meaningful. In addition, the $F$ statistic reveals that $R^2(2), R^2(3),$ and $R^2(4)$ are not statistically significant and thus will not be interpreted.

Table 38
Canonical Correlation Analysis

<table>
<thead>
<tr>
<th>Function</th>
<th>Squared Eigen Value</th>
<th>Canonical Correlation</th>
<th>Canonical Correlation</th>
<th>F Test</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.453</td>
<td>.557</td>
<td>.312</td>
<td>2.059</td>
<td>.011</td>
</tr>
<tr>
<td>2</td>
<td>.033</td>
<td>.178</td>
<td>.032</td>
<td>.381</td>
<td>.943</td>
</tr>
<tr>
<td>3</td>
<td>.009</td>
<td>.092</td>
<td>.008</td>
<td>.256</td>
<td>.905</td>
</tr>
<tr>
<td>4</td>
<td>.005</td>
<td>.071</td>
<td>.005</td>
<td>.386</td>
<td>.536</td>
</tr>
</tbody>
</table>

Wilks Lambda = .657, $F=2.059$ (df 16, 224), $p = .01$

Standardized Canonical Coefficients

Canonical weights (standardized canonical coefficients) are used as indices of the relative importance of a variable to the canonical variate (function). The researcher selects
the variables which indicate a relatively high coefficient in relationship to the other variables within a given function. Table 39 shows that for the criterion variables set, student creating is most important for canonical variate 1. For the predictor variables set, teacher remembering, teacher processing, and teacher creating were relatively important for Function 1.

**Structure Coefficients**

The structure coefficients are a product-moment correlation between the original variables in each set and the canonical variate scores for a given canonical variate (function). The rule of thumb is to treat as meaningful structure coefficients those which are equal to or greater than .30. A structure coefficient can also be interpreted as a factor loading.

For this study, the magnitude of structure coefficients were interpreted as follows:

- .25 or lower: Low
- .26 to .64: Moderate
- .65 or greater: High

On the predictor variables set, teacher creating (.903), teacher evaluating (.931), and teacher processing (.781) loaded highest on canonical variate 1. This indicates that higher values of teacher remembering, processing, creating, and evaluating are associated with higher canonical variate scores on the predictor canonical variate 1.
### Table 39

**Summary of Canonical Correlation Analysis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Canonical Variate 1</th>
<th>Canonical Variate 2</th>
<th>Canonical Variate 3</th>
<th>Canonical Variate 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>s</td>
<td>b</td>
<td>s</td>
</tr>
<tr>
<td><strong>Predictor Variable Set</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Remembering</td>
<td>.889</td>
<td>.507</td>
<td>.146</td>
<td>-.822</td>
</tr>
<tr>
<td>Teacher Processing</td>
<td>-.702</td>
<td>.781</td>
<td>-1.042</td>
<td>-.561</td>
</tr>
<tr>
<td>Teacher Creating</td>
<td>.794</td>
<td>.903</td>
<td>1.304</td>
<td>.364</td>
</tr>
<tr>
<td>Teacher Evaluating</td>
<td>.409</td>
<td>.931</td>
<td>-.397</td>
<td>.119</td>
</tr>
<tr>
<td>Proportion of Variance</td>
<td>.637</td>
<td>.284</td>
<td>.031</td>
<td>.047</td>
</tr>
<tr>
<td><strong>Criterion Variable Set</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Remembering</td>
<td>.367</td>
<td>.541</td>
<td>.223</td>
<td>.216</td>
</tr>
<tr>
<td>Student Processing</td>
<td>-.108</td>
<td>-.099</td>
<td>-.653</td>
<td>-.651</td>
</tr>
<tr>
<td>Student Creating</td>
<td>-.760</td>
<td>-.908</td>
<td>-.144</td>
<td>-.023</td>
</tr>
<tr>
<td>Student Evaluating</td>
<td>-.236</td>
<td>-.428</td>
<td>.738</td>
<td>.709</td>
</tr>
<tr>
<td>Proportion of Variance</td>
<td>.327</td>
<td>.243</td>
<td>.211</td>
<td>.218</td>
</tr>
<tr>
<td>Redundancy</td>
<td>.102</td>
<td>.008</td>
<td>.002</td>
<td>.001</td>
</tr>
<tr>
<td>$R_c^2(1) = .312$</td>
<td>$R_c^2(2) = .032$</td>
<td>$R_c^2(3) = .009$</td>
<td>$R_c^2(4) = .005$</td>
<td></td>
</tr>
</tbody>
</table>

_b=Standardized Canonical Coefficient; s=Structure Coefficient_
On the criterion variables set, student creating loaded highest on canonical variate 1. The structure coefficients for the criterion variables set indicates that lower scores by students on creating and evaluating are associated with higher scores on canonical variate 1. Conversely, higher scores by students on the remembering tests are associated with higher scores on canonical variate 1.

The redundancy index (Table 39) for canonical function 1 indicates that 10.2 percent of the variance in the criterion variable set is explained by the predictor variable set.

Canonical Correlation Summary

To summarize, the canonical correlation analysis indicated a significant relationship between the predictor variable set (percentage of teachers' instructional objectives classified as remembering, processing, creating, and evaluating) and the criterion variable set (students' percentage scores on remembering, processing, creating, and evaluating tests). When intercorrelations among predictor and criterion variables are considered, the relationship between the two sets of variables indicates, generally, that higher percentages of the teachers' instructional objectives classified as remembering, processing, creating, and evaluating are accompanied by lower test scores of students on creating and evaluating test items and higher test scores on remembering test items.
CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

Purpose of the Study

The purpose of this study was to determine at what level of cognition ten selected teachers of production agriculture from secondary schools in Ohio were teaching their vocational agriculture students. In addition, this study sought to ascertain at what cognitive level the students of the production agriculture teachers selected for this study were performing. The cognitive levels of instruction were identified by evaluating instructional objectives in the individual teacher's course of study. The students' level of cognitive performance was measured by a test developed by the researcher.

The following research questions were developed to guide this study.

1. How can the selected production agriculture teachers be described in terms of age, marital status, gender, program enrollment, number of years in the teaching profession, highest educational degree attained, and number of years in their current position?
2. What subject matter was taught by the selected production agriculture teachers during the 1987-1988 academic year based on an examination of their courses of study?

3. What was the cognitive level of instruction utilized by the selected production agriculture teachers as measured by the Newcomb-Trefz Model of Cognitive Development based upon the teachers' courses of study?

4. To what extent did the cognitive level of instruction differ among the grade levels (ninth, tenth, eleventh, and twelfth) and subject matter areas as indicated by the teachers' courses of study?

5. To what extent did the students of the selected production agriculture teachers perform at the various levels of cognition based upon a researcher developed written test?

6. What was the relationship between the level of cognition of instruction as measured by the teachers' courses of study and the cognitive performance level of the students?

Methodology

To answer the research questions posited, data were obtained by reviewing the courses of study of the production agriculture teachers selected for this study. The
twelfth-grade students of the production agriculture teachers selected for the study were the population for the written examination developed by the researcher.

Population and Subject Selection

The target population for this study was production agriculture teachers in public secondary schools in Ohio. The students of the production agriculture teachers were the target population for ascertaining the students' level of cognitive performance.

The production agriculture teachers were purposefully selected as the population for the study. The sample size was limited to 10 production agriculture teachers identified by the faculty of the Department of Agricultural Education at The Ohio State University and state supervisors from the Ohio Department of Education, Vocational Education Division, Agricultural Education Service (Appendix E) as having state approved courses of study.

The students selected for this study were the twelfth-grade students enrolled in the vocational agriculture classes taught by the production agriculture teachers who were selected for this study during the 1987-1988 academic year. All twelfth-grade students were selected to take a test to ascertain the level of cognitive performance.

Research Design

The descriptive method of research was utilized in this study. To answer the research questions posited, data were
collected by reviewing the courses of study of the production agriculture teachers. The twelfth-grade students of the production agriculture teachers selected for the study were the population for the written examination developed by the researcher.

Instrumentation

The course of study prepared by each production agriculture teacher was used to determine the level of cognition of instruction and the percentage of time spent on instruction in each of the five subject areas (leadership, crop production, animal science, agricultural mechanics, and farm management). The course of study was carefully reviewed page by page by the researcher. During the review of the course of study, the researcher classified each instructional objective written in each of the courses of study. The instructional objectives were classified into the cognitive levels identified by Newcomb and Trefz (1987). The taxonomy based vocabulary list (Appendix C) was used as a guide for the classification of the instructional objectives. In addition, the researcher categorized the instructional objectives into the appropriate subject area and indicated the required number of class days allotted for instruction in each specific subject area.

Reliability on the demographic questionnaire was established for this instrument by comparing selected information supplied by the production agriculture teachers
to the same data available from the Ohio State Department of Education, Division of Vocational and Career Education, Agricultural Education Service. Through this verification procedure, the information reported by the production agriculture teachers was judged to be reliable.

A paper-pencil test developed by the researcher was administered to the twelfth-grade students enrolled in vocational agriculture programs taught by the selected production agriculture teachers. The paper-pencil test was constructed after reviewing the courses of study to ensure that the paper-pencil test questions were related to subject matter which had been part of the students' instruction.

The paper-pencil test was developed in four parts, two parts (remembering and processing) consisting of 50 multiple choice questions per section and two parts (creating and evaluating) consisting of 30 multiple choice questions per section. Questions for the remembering and processing level were obtained from the Ohio Production Agriculture Achievement Test: Part I and Part II. An assessment of the Achievement Test was conducted and the questions were classified into their respective level of cognition utilizing the Newcomb-Trefz Model (1987). The results of the assessment indicated that all 350 questions in the Achievement Test were at the remembering or processing level.

Following the assessment of the Achievement Test, the researcher took a randomized proportional sample of
questions in each of the five instructional areas (leadership, crop production, animal science, agricultural mechanics, and farm management) in the remembering and processing cognitive levels. The proportion of questions was determined by following the state recommendation of percent of school time to be devoted to instruction in the various instructional areas. The state recommended percentage of instructional time was: leadership, 5%; crop production, 25%; animal science, 25%; agricultural mechanics, 30%; and, farm management 15%.

Remembering and processing questions were randomly selected in proportion to the percent of time devoted to each instructional area. A total of 50 questions was randomly selected for the remembering and processing levels of cognition.

Questions at the creating and evaluating level were developed by the researcher. Thirty questions at each cognitive level (creating and evaluating) were written.

The 160 question paper-pencil test (50 remembering level questions, 50 processing level questions, 30 creating level questions, and 30 evaluating level questions) was reviewed for content validity by a panel of teacher educators and former high school vocational agriculture teachers (Appendix I). The 160 question paper-pencil test was pilot tested for reliability and suitability using twelfth-grade production agriculture students from two production
agriculture programs which were not selected for this study.

The reliability test using Cronbach's alpha, which is equivalent to Kuder-Richardson 20 by coding the data as dichotomous (SPSS User's Guide, 1986), produced the following coefficients: remembering questions, Cronbach's alpha = .87; processing questions, Cronbach's alpha = .85; creating questions, Cronbach's alpha = .80; and, evaluating questions, Cronbach's alpha = .79. The researcher purposely selected the 25 questions in each of the cognitive levels (remembering, processing, creating, evaluating) which received the highest item-total correlation score in each respective cognitive level. The 100 question test (25 remembering questions, 25 processing questions, 25 creating questions, and 25 evaluating questions) was again reviewed for content validity by a panel of teacher educators and former high school vocational agriculture teachers (Appendix I). Following the second review for content validity, the researcher conducted another test for reliability using Cronbach's alpha. The resultant reliability coefficients were: remembering, Cronbach's alpha = .91; processing, Cronbach's alpha = .90; creating, Cronbach's alpha = .84; and, evaluating, Cronbach's alpha = .82.

The paper-pencil test was mailed to the selected production agriculture teachers with specific instructions for administration (Appendix H). The test was administered by the production agriculture teachers to all twelfth-grade
students as instructed on May 23, 1988, and May 24, 1988. There was not a specified amount of time alloted to the students to answer the questions on the test.

Data Collection

Data to determine the level of cognition of instruction were collected by means of the researcher carefully reviewing the course of study of each individual production agriculture teacher selected for this study and classifying each instructional objective written in the course of study. At the onset of the study, the researcher mailed a letter to each selected production agriculture teacher detailing the objectives of the study and asking for their cooperation and participation in the study (Appendix F).

The researcher telephoned all selected production agriculture teachers approximately one week after the mailing of the letter to confirm their participation in the study. At this point, once confirmed as participants, the researcher requested the production agriculture teachers to mail their courses of study to the researcher or bring the course of study to The Ohio State University. Several of the production agriculture teachers brought their course of study to the researcher at The Ohio State University. The production agriculture teachers who did not personally deliver their course of study to the researcher, mailed their course of study.
Data to determine the demographic characteristics of the production agriculture teachers were collected by the researcher via a questionnaire (Appendix G). These data were collected when the student test was mailed to the selected production agriculture teachers. The demographic questionnaire was returned to the researcher by return mail.

Data to ascertain the level of cognitive performance of the students was collected via a paper-pencil test. The test was administered by the selected production agriculture teachers on May 23, 1988, and May 24, 1988. The researcher mailed the student paper-pencil test to the production agriculture teachers with specific instructions for administration (Appendix H).

Data Analysis

All data were analyzed using the Statistical Package for Social Sciences (SPSSX) at the Instructional and Research Computing Center of The Ohio State University using an a priori alpha level of .05.

The first research question sought to describe the production agriculture teachers. The data for research question one were analyzed using descriptive statistics consisting of frequencies, percentages, means, and standard deviations.

The second research question sought to describe the subject matter taught by the production agriculture teachers during the 1987-1988 academic year. This information was
analyzed using frequencies, percentages, and means.

The third research question sought to determine the cognitive level of instruction utilized by the production agriculture teachers as measured by the Newcomb-Trefz Model. This data was analyzed by using descriptive statistics consisting of frequencies, percentages, and means.

The fourth research question sought to determine the extent to which the cognitive level of instruction differed among the grade levels and subject matter areas. The data for research question four were analyzed by employing a one-way analysis of variance.

The fifth research question sought to determine the extent to which the students of the production agriculture teachers performed at the various levels of cognition based upon a researcher developed paper-pencil test. These data were analyzed by using frequencies, percentages, and means.

The last research question sought to determine if a relationship existed between the level of cognition of instruction and the cognitive performance level of the students. The data for research question six were analyzed via canonical correlations.

**Summary of Findings**

Demographic Characteristics of Teachers

The ten teachers that made up the sample for this study were purposefully selected production agriculture teachers in the state of Ohio. Data were collected on the following
characteristics.

Age

The mean age for the production agriculture teachers was 35.8 years. Sixty percent of the production agriculture teachers were age 39 or younger.

Marital Status

All production agriculture teachers were married.

Gender

All production agriculture teachers were male.

Years in Teaching Profession

Seventy percent of the production agriculture teachers reported teaching for 15 years or less. The mean number of years teaching was 13.4 years.

Program Enrollment

The mean program enrollment reported by the teachers was 39.2 students. Seventy percent reported an enrollment of 40 students or less.

Educational Attainment

Fifty percent of the production agriculture teachers had earned a Master's degree. The remaining fifty percent reported to have earned a Bachelor's degree.

Years in Current Position

The mean number of years in the current teaching position reported by the production agriculture teachers was 12.1 years. Seventy percent reported to have been in their current teaching position 12 years or less.
Subject Matter Taught

Data were collected related to the number of school days reported in the course of study by the production agriculture teachers devoted to instruction in the selected subject areas.

Approximately 9 percent of the instructional time was devoted to leadership, 16 percent to crop production, 18 percent to animal science, 41 percent to agricultural mechanics, and 17 percent to farm management.

Cognitive Level of Instruction

Data were collected related to the level of cognition of instruction by subject area and grade level as indicated by the courses of study of the production agriculture teachers.

Distribution of Instructional Objectives Across Levels of Cognition

Thirty-one percent of the instructional objectives were written at the remembering level. Approximately 38 percent of the instructional objectives were written at the processing level, 19 percent at the creating level, and 12 percent at the evaluating level.

Distribution of Instructional Objectives by Subject Area

Approximately 16 percent of the instructional objectives were written in the subject area of leadership. In the area of crop production, the percentage of instructional objectives was approximately 19. Approximately 18 percent
of the instructional objectives were written in the animal science subject area. Agricultural mechanics instructional objectives accounted for approximately 30 percent and the subject area of farm management accounted for 17 percent.

**Distribution of Instructional Objectives Across Levels of Cognition by Grade Level**

Sixty-eight percent to 72 percent of the instructional objectives written in the courses of study by the production agriculture teachers at all grade levels were written at the lower (remembering and processing) levels of cognition.

**Distribution of Objectives in the Area of Leadership**

The distribution of leadership objectives was approximately 34 percent remembering, 38 percent processing, 20 percent creating, and 8 percent evaluating.

**Distribution of Objectives in the Area of Crop Production**

Approximately 34 percent of the crop production instructional objectives were written at the remembering level, 41 percent at the processing level, 15 creating, and 10 percent at the evaluating level.

**Distribution of Objectives in the Area of Animal Science**

The production agriculture teachers wrote approximately 31 percent of the animal science instructional objectives at the remembering level. In addition, approximately 41 percent of the animal science instructional objectives were written at the processing level, 15 percent at the creating level, and 13 percent at the evaluating level.
Distribution of Objectives in the Area of Agricultural Mechanics

The production agriculture teachers wrote approximately 30 percent of the agricultural mechanics instructional objectives at the remembering level. In addition, approximately 35 percent, 21 percent, and 15 percent of the instructional objectives were written at the processing, creating, and evaluating level respectively.

Distribution of Objectives in the Area of Farm Management

Approximately 28 percent of the farm management instructional objectives were written at the remembering level, 39 percent at the processing level, 21 percent at the creating level, and 12 percent at the evaluating level.

Differences Among Level of Cognition of Instruction by Grade Level and Subject Area

The null hypothesis tested was that the average percent of instructional objectives written by the production agriculture teachers among the grade levels within each cognitive level and subject area were equal. This test was conducted by using a one-way analysis of variance (ANOVA). If significant differences were noted, Tukey-HSD post-hoc analysis was utilized to determine the groups with the significantly different average percent.

Remembering Level

No significant differences except as follows: between the eleventh-grade level and the ninth- and tenth-grade
levels at the remembering level in the subject area of agricultural mechanics. Teachers were writing significantly more agricultural mechanics instructional objectives at the remembering level at the eleventh-grade than at the ninth-or tenth grade level.

Differences were also noted between the twelfth-grade level and the ninth-, tenth-, and eleventh-grade levels at the remembering level of cognition in the subject area of farm management. This indicated that the teachers wrote significantly more farm management instructional objectives at the twelfth-grade level than at the ninth-, tenth-, and eleventh-grade at the remembering level of cognition.

Processing Level

Significant differences were noted between the tenth-grade level and the eleventh- and twelfth-grade levels in the subject area of crop production at the processing level of cognition. This significant difference indicates that the teachers were writing more crop production instructional objectives at the tenth-grade level than at the eleventh- and twelfth-grade level at the processing level of cognition.

In the subject area of animal science, significant differences were noted between the ninth-grade level and twelfth-grade level at the processing level of cognition. This significant difference indicates that the teachers were writing more animal science processing level instructional
objectives at the ninth-grade level than at the twelfth-grade level.

Significant differences were noted between the eleventh-grade level and the ninth-grade level in the subject area of agricultural mechanics at the processing level of cognition. This significant difference indicates that the teachers were writing more agricultural mechanics instructional objectives at the eleventh-grade level than at the ninth-grade level at the processing level of cognition.

In addition, significant differences were noted between the twelfth-grade level and the ninth-, tenth-, and eleventh-grade levels in the subject area of farm management at the processing level of cognition. Teachers were writing significantly more farm management instructional objectives at the twelfth-grade level than at the ninth-, tenth-, and eleventh-grade levels at the cognitive level of processing.

Creating Level

Significant differences were noted between the eleventh-grade level and the twelfth-grade level in the subject area of animal science at the creating level of cognition. Teachers were writing significantly more creating level instructional objectives in the subject area of animal science at the eleventh-grade level than at the twelfth-grade level.
Evaluating Level

Significant differences were noted between the twelfth-grade level and the tenth- and eleventh-grade levels in the farm management subject area at the evaluating level of cognition. This difference indicated that the teachers were writing significantly more farm management instructional objectives at the twelfth-grade level than at the tenth- and eleventh-grade level at evaluating cognitive level.

Student Performance

Data were collected related to the level of cognition of student performance via a paper-pencil test administered to the twelfth-grade students of the selected production agriculture teachers.

The mean score of correctly answered questions at each level of cognition was: remembering, approximately 64 percent; processing, 55 percent; creating, 40 percent; and, evaluating, 28 percent.

Relationship Between Level of Cognition of Instruction and Student Level of Cognitive Performance

The canonical correlation analysis indicated a significant correlation between the predictor variable set (percentage of teachers' instructional objectives classified as remembering, processing, creating, and evaluating) and the criterion variable set (students' percentage scores on remembering, processing, creating, and evaluating tests). When intercorrelations among predictor and criterion
variables are considered, the relationship between the two sets of variables indicates, generally, that higher percentages of teachers' instructional objectives classified as remembering, processing, creating, and evaluating are accompanied by lower test scores of students on creating and evaluating test items and higher test scores on remembering and processing test items.

Discussion of Findings

A review of the related literature indicated that there was a need for, or least an interest in, the classification of cognitive operations and instructional objectives. Previous researchers have drawn conclusions, many of which have been supported, and some which have not been supported, by the findings in this study. The discussion on the findings of this study ensues.

Subject Matter Taught

The Ohio Department of Education, Vocational Education Division, Agricultural Education Service, has developed a set of recommended percentages of time for teachers of agriculture to utilize in the development of their course of study. The recommended percentages are leadership, 5 percent; crop production, 25 percent; animal science, 25 percent; agricultural mechanics 30 percent; and farm management 15 percent.

The production agriculture teachers in this study were not following the State's recommendation. It is evident
that the production agriculture teachers are devoting greater percentages of time to some subject areas than is recommended and conversely spending less time in other areas than is recommended. For example, the production agriculture teachers in this study were devoting approximately 41 percent of the instructional time to the subject area of agricultural mechanics while the recommend percentage of instructional time was 30 percent.

With nearly twice as much as the state's recommendation in the percent of instructional time devoted to leadership, this researcher begins to wonder if the image that teachers of agriculture teach "too much FFA" is correct. In addition, teachers of agriculture are also accused of being "shop teachers." With nearly 41 percent of the instructional time spent on agricultural mechanics, one may wonder if indeed that is also not true.

Sometime ago, the State Department of Education set down the aforementioned recommendations; perhaps for the purpose of providing what was supposed to have been a "well rounded" instructional program in the area of agriculture. If the recommendations are not being followed, does it indicate that agricultural education in the public schools has outlived or outgrown the previous recommendations? Do the teachers of agriculture know, more so than the State Department of Education staff, what is the proper percentages of instructional time to devote to the various subject
matter and are doing so? Is now the time to re-evaluate the recommended percentages of time in order to change or restructure the programs of production agriculture?

Currently, agricultural education in the public schools is undergoing change. Do the findings in this study indicate the requisite change for which agricultural education is asking? Or, could it be that regardless of state recommendations, the teachers are going to teach what subject matter they choose to teach?

Cognitive Level of Instruction

In most studies which have been conducted, researchers (Gall, 1970; Ryan, 1974; Floyd, 1961; Gallagher, 1965; Davis & Tinsley, 1967) have determined that most teachers' questions or objectives call for lower level thinking -- the recall of factual information. Gall (1970) in another study of teachers' questioning practices, found that 60 percent of the teachers' questions required students to merely recall facts (remembering) that had been presented to them, about 20 percent were procedural (processing) in nature, and only 20 percent required students to actually engage in thought beyond the level of recall facts (creating and evaluating).

Other researchers (Billeh, 1974; Bloom & others, 1956; Bloom, 1972; Davis & others, 1969; and Doak, 1970) concluded that both the test items and oral teacher questions classified in their respective studies, generally fell into the lowest levels of Bloom's Taxonomy. Newcomb and Trefz (1987)
found that the distribution of learning across the levels of cognition at the college level was 37 percent remembering, 44 percent processing, 6 percent creating, and 13 percent evaluating.

The data in this study does not seem to follow the previous researchers' findings. The production agriculture teachers had only 31 percent of the instructional objectives at the remembering level while Gall (1970) concluded that 60 percent was the norm. It is quite evident that the teachers in this study write fewer instructional objectives at the remembering level than is expected by the literature. This researcher begins to wonder if the teachers' pre-service training had an effect on the level of cognition at which the teachers write their instructional objectives.

Granted, the majority of the instructional objectives classified were at the remembering or processing level, however, there were still nearly 30 percent at the creating and evaluating level. This percent is above the 20 percent estimated by Gall (1970). Newcomb and Trefz (1987) in the College of Agriculture study evaluated written tests. However, from this analysis, Newcomb and Trefz (1987) found that only 19 percent of the learning occurred at the creating and evaluating level. In this study, the teachers of agriculture are writing instructional objectives at higher cognitive levels than the literature has suggested, but it is not clear why this is the case.
These findings may be the result of the method of instruction which is delivered by the production agriculture teachers. Teachers of vocational agriculture who obtain their educational training at The Ohio State University, learn the "problem solving approach" to teaching. The "problem solving approach" to teaching purports to utilize teacher questions and instructional objectives at the higher cognitive levels to a greater extent than does "traditional" teaching. Relatedly, Kirts and Stewart (1983) concluded that student teachers in agriculture who used a problem solving approach to teaching, asked more questions of both higher and lower levels than other student teachers who did not use the same approach to teaching.

Another factor which may influence the higher level of creating and evaluating instructional objectives may be due to the laboratory experiences and the supervised occupational experience which are part of the total instructional program. With nearly 41 percent of the instructional time devoted to agricultural mechanics, much of which occurs in a laboratory setting, creating and evaluating objectives would be more common. The objectives of a supervised occupational experience program, in part, are to create new and innovative ideas that will promote and expand the program and evaluate the current program for improvement.

Billeh (1974) concluded that teachers with more experience seem to ask more questions at the lower levels of
cognition. However, Billeh (1974) did not indicate how many years of experience were necessary before a teacher became an "experienced teacher." The mean number of years of teaching of the production agriculture teachers may not be enough to qualify as an "experienced teacher" using Billeh's standards. Whatever the reason, the production agriculture teachers write more instructional objectives at the higher (creating and evaluating) cognitive levels than the literature has suggested.

Differences Among Level of Cognition of Instruction By Grade Level and Subject Area

The literature indicated that question levels did not differ among different subjects and different grade levels (Billeh, 1974). This study of production agriculture teachers and students found Billeh's (1974) conclusions not to be applicable to the findings in this study.

In the subject area of farm management, there were several significant differences noted between different grade levels. The teachers wrote significantly more farm management instructional objectives at the twelfth-grade level at all levels of cognition except creating. This trend is good at the evaluating level, but one may question if this is good at the remembering or processing cognitive level. This researcher would expect that more instructional objectives would be written at the remembering level at the ninth-grade than at the twelfth-grade. Perhaps the same
could be true at the processing level of cognition.

In addition, significant differences were also noted in the subject area of agricultural mechanics. This difference however, indicated that the teachers were writing more instructional objectives at the eleventh-grade level than at the ninth- and tenth-grade levels at the remembering level of cognition. Likewise, in the subject area of agricultural mechanics, at the processing level of cognition, the teachers were writing more instructional objectives at the eleventh-grade level than at the ninth-grade level.

To continue within the processing level of cognition, the teachers wrote more instructional objectives at the tenth-grade level than at the eleventh- and twelfth-grade levels in the subject area of crop production.

In the subject area of animal science, at the cognitive level of processing, the teachers wrote more instructional objectives at the ninth-grade level than at the twelfth-grade level. At the creating level of cognition, the teachers wrote more instructional objectives at the eleventh-grade level than at the twelfth-grade level.

Following the inconsistent pattern previously presented, is this the pattern which one would expect to find across all grade levels and all subject areas? The variation indicates that the teachers are elevating somewhat the cognitive level of their instruction accordingly within the agricultural mechanics, farm management, and animal science
subject areas.

Does the evidence suggest that the production agriculture teachers are consciously trying to vary the instruction by grade level and by subject area or is this purely coincidental? This researcher would hypothesize that given the current pre-service training, the variation has occurred by chance. There has been no conscious manipulation by the teachers, nor has there been any evidence of pre-service training of teachers to make them cognizant of the levels of cognition.

Student Performance Within the Various Levels of Cognition

Student performance within the various levels of cognition indicated that the students were capable of performing at much higher levels than the level of the instruction they were receiving. While some may argue that the student scores were low, this researcher maintains that they were not. Although there are no previous studies from which to draw comparisons, this researcher would argue that if compared to students in general, the agriculture students would score significantly better at each level of cognition.

It has been discussed that the teachers were teaching at higher cognitive levels than the literature would suggest. Previous research studies (Buggey, 1972; Tyler, 1980; Hunkins, 1969) have indicated that the achievement of students was significantly and positively affected by the teachers level of teaching. Perhaps that is one reason why
the students scored fairly well at all levels of cognition as indicated by the results of this study.

In addition, the use of the "problem solving approach" to teaching by the production agriculture teachers may have a positive impact on the students' ability to use problem solving skills and later retrieval and use of information. Although Bloom (1956) concluded that it could not be determined if any one level of cognition allows the student to have a longer retention span which in turn permits the student to be able to utilize the information at a later time, Young (1982) has argued that the nature of the instruction did have an impact on later retrieval and utilization of information.

Relationship Between Cognitive Level of Instruction and Student Performance Across Levels of Cognition

The relationship which occurs between the level of cognition of instruction and the level of student cognitive performance should be high. A high relationship would indicate that the teachers and students are in concert with each other. A low relationship would indicate that the teachers and the students are in conflict with each other.

By using the canonical correlation analysis procedure, the results of this study indicated that there is a substantial relationship between the teachers' percent of instructional objectives at the various levels of cognition and the students' level of performance. The intercorrelations among
predictor and criterion variables indicate, generally, that higher percentages of the teachers' instructional objectives classified as remembering, processing, creating, and evaluating are accompanied by lower test scores of students on creating and evaluating test items and higher test scores on remembering test items.

The results of this study tend to support the finding of Winne (1979), Billeh (1974), and Hunkins (1969). Studies of the relationship between the level of cognition of instruction and the student level of cognitive performance have indicated that a relationship may exist between the level of the teacher's teaching and student achievement (Winne, 1979). In a similar study, Billeh (1974) concluded that the level of the teacher's questions had a direct relationship to the cognitive level that the students had to employ to arrive at satisfactory responses to the questions. Hunkins (1969) found that students, guided in their study by a preponderance of analysis-evaluation questions scored significantly higher on a post-test of achievement than those students guided by a preponderance of knowledge-type questions written for the same materials.

Conclusions and Implications

Conclusions

The following conclusions are based on the interpretation of data presented in this study.
Conclusion 1: The production agriculture teachers are devoting a greater percentage of time to some subject areas than is recommended and conversely spending less time in other areas than is recommended. The teachers are emphasizing agricultural mechanics and leadership development at the expense of other subject areas.

Conclusion 2: Teachers of agriculture are writing more instructional objectives at higher cognitive levels (creating and evaluating) than suggested by the literature. Conversely, fewer instructional objectives are being written at the lower cognitive levels (remembering and processing) than the literature would suggest.

Conclusion 3: The teachers of agriculture are raising the cognitive level of the instructional objectives within the grade levels in some subject areas. The subject area of farm management seems to be the only subject area where a pattern of variation has occurred.

Conclusion 4: The students performed better at the various levels of cognition as compared to the findings in previous studies.

Conclusion 5: There is a significant relationship between the level of cognition of instruction (measured by percent of instructional objectives) and the student level of cognitive performance.

Conclusion 6: Higher percentages of teachers' instructional objectives are accompanied by lower test scores by students.
on creating and evaluating test items and higher test scores on remembering test items.

Implications

Implication 1: While 50 percent of the instruction being received by the students in agricultural education is in the area of leadership and agricultural mechanics, the areas of dynamic growth in the agricultural sector are not being addressed. The areas of farm management, agricultural business, agricultural communications, biotechnology, and science oriented curriculums are not being taught. Why do agricultural educators continue to place heavy emphasis on "shop work" and "FFA?" Unless, a drastic change is made to incorporate innovative and non-traditional subject matter in agricultural education, one can expect to eventually run out of students who would enroll in the "traditional" agricultural education program.

Implication 2: With instruction in the development of instructional objectives at the various levels of cognition, the teachers of agriculture could begin to write a greater number of instructional objectives, which are the basis for instruction, at higher levels of cognition. This situation would further challenge the students enrolled in agricultural education programs to engage in a more meaningful learning experience.
Recommendations for the Agricultural Education Profession

1. The Ohio Department of Education, Vocational Education Division, Agricultural Education Service, and The Ohio State University Department of Agricultural Education, should re-evaluate the recommended percentages of time allocated to the various subject areas. With the current trend to re-examine or re-develop the agricultural education curriculum in the public schools, the time is ripe for agricultural educators to seek alternatives to the current curriculum offerings and re-establish new recommendations.

2. All agricultural education programs across the State of Ohio should assess the level of cognition of instruction being delivered to their students. If the cognitive level of instruction is found to be unacceptable by some predetermined standard, then corrective action should be taken to develop a curriculum which cognitively challenges the students.

3. In an effort to make the pre-service teachers cognizant of the level of cognitive development, the Department of Agricultural Education at The Ohio State University, should include a unit of instruction on recognizing and writing instructional objectives at the various levels of cognition.

4. The teachers of agriculture in the public schools should make a concerted effort to elevate the cognitive level of their instruction as the student progresses to higher grade
levels.

5. The teachers of agriculture should purposefully create learning situations which would assist in the development of higher cognitive abilities in students.

Recommendations for Future Research

1. Additional attempts should be made to study cognitive development in other vocational programs in Ohio. The characteristics identified should be compared to vocational agriculture programs in an attempt to determine how agricultural education is doing in comparison to the other vocational programs.

2. Studies should be conducted that assess the actual level of cognitive instruction being delivered by the teachers during actual classroom instruction. The results of this should be compared with the instructional objectives written in the course of study.

3. Students at all grade levels should be tested to determine if there is a significant difference in the student level of cognitive performance by grade levels. The results could be correlated with the teachers level of cognitive instruction by grade level.

4. The actual grade point averages (GPA) of the students should be collected and correlated with their level of cognitive performance to determine the contribution of GPA towards the level of cognitive performance.
5. An experimental study should be conducted where there would be two experimental groups (traditional teaching and problem solving approach to teaching). The students would be given a pre-test prior to the instruction to ascertain the level of cognitive performance and a post-test after the instruction. The scores on the two tests would be compared to determine if the method of instruction has a significant contribution to the student's level of cognitive performance.

Recommendations for Research Methodology

1. Further research in this area should consider using a larger sample size of teachers and students.
APPENDIX A

LEVELS OF COGNITION DESCRIBED

BLOOM'S TAXONOMY
DESCRIPTION OF BLOOM'S TAXONOMY

I. Knowledge Level
   A. Consists of memorizing or identifying facts. It is a student's "file" of information that can be recalled or brought to mind later. It provides the basis for greater understanding (Chamberlain and Kelly, 1981).
   B. The knowledge level itself ranges from specific, concrete facts, or information to more complex and abstract theory. The taxonomy level of knowledge is divided into the following sub-levels (Hunkins, 1972):
      1. Knowledge of Specifics - the recall of specific, separate bits of information. This type of question provides the student with a data base.
         a. Knowledge of terminology - definitions
         b. Knowledge of specific facts - includes dates, events, persons, places, etc
      2. Knowledge of Ways and Means of Dealing with Specifics - knowledge of the ways of organizing, studying, judging, and criticizing. Does not require the student to be able to understand or utilize the concept; only requires an
Knowledge Level (continued)

awareness of the concept.

a. Knowledge of conventions - awareness of accepted ways of dealing with types of information or situations. Example: "What is the correct form for a business letter?"

b. Knowledge of trends and sequences - questions student's knowledge of various phenomena in relation to the dimension of time. The emphasis is not on student understanding of the trend, but only that they recognize it exists. Example: "What were the events that led up to World War II?"

c. Knowledge of classifications and categories - emphasis is placed upon the students remembering certain groupings of information. They are not required to do anything with the categories; they are only asked to recall from memory certain classifications. Example: "What are the four basic food groups, and which foods are contained in each?"

d. Knowledge of criteria - emphasis is on awareness of criteria developed. Identification or listing of criteria is requested; not an understanding of the basis for
Knowledge Level (Continued)

establishment of criteria. Example: "Name three criteria for judging the quality of a cut of meat."

e. Knowledge of methodology - this dimension is only concerned with the student's awareness of several methods or processes, not his ability to apply them to actual situations. Example: "If a teacher wishes to individualize instruction, the first step should be to:

(1) Select materials.
(2) Consider his/her own competencies.
(3) Diagnose the abilities, needs, and interests of the students in class.
(4) Get permission from the principal.

f. Knowledge of the Universals and Abstractions in a Field - deals with knowledge of principles and generalizations and knowledge of theories and structures. Questions at this level are asking only for an awareness of various abstractions. Example: "What is the basic structure of the discipline of economics, as presented in class?"
II. COMPREHENSION

A. This level focuses on the meaning and intent of the material. It involves the ability to understand the literal meaning of the subject matter. The comprehension level has been divided into three sub-levels (Hunkins, 1972).

1. Translation - focuses on the student's ability to translate or paraphrase information from one to another. Knowledge is required, but the emphasis is on using this knowledge to understand material. Translation could involve:
   a. repeating what the author said, using the learner's own words.
   b. translation of a foreign language into English.
   c. translation of material from technical terms into layman's terms.

2. Interpretation - the emphasis is on grasping the basic ideas or general meaning of the material.
   a. The learner must be able to translate each major part of the material so that it becomes meaningful.
   b. The learner must then rearrange or reorder the material to determine significant and non-significant portions.
Comprehension Level (Continued)

c. The learner must finally be able to relate the information (fact, generalization, definition, skill, etc.) to new situations.

3. Extrapolation - extends the ability to translate and interpret by student's expanding the information to determine implications, consequences, effects, etc., based on the original communication.

III. APPLICATION

A. Education should be preparation for life. Application questions are designed to give students practice in the transfer of training; applying what has been learned to other situations and learning tasks.

B. There are three main characteristics of questions in the application category (Sanders, 1966).

1. They deal with knowledge which has explanatory or problem-solving power - the kind of knowledge transferable to many situations.

2. They deal with whole ideas and skills, rather than solely with parts.

3. They include a minimum of directions or instructions; part of the challenge lies in the student being able to determine the
Application Level (Continued)

appropriate problem-solving process to use.

C. Evidence shows that once the ability to make application is developed, it is likely to be one of the more permanent acquisitions in learning (Bloom et al., 1981).

V. ANALYSIS

A. Analysis may be regarded as a further step in the "comprehension" of an idea, product, or document. It requires the student to "see" the underlying ideas, devices, and workings of a document or communication (Bloom et al., 1981).

B. While analysis is slower and more difficult than the comprehension process, it is very important to use where deeper understanding is required before decisions are reached and problems are attacked (Bloom et al., 1981).

C. It is likely that once analytical abilities are developed in a number of fields of knowledge, they can be applied to new problems in a creative way (Bloom et al., 1981).

D. Analyzing includes: (1) separating relevant material from trivia; (2) distinguishing facts from hypotheses; and (3) differentiating between objective data and value judgement (Chamberlain and
Analysis Level (Continued)


E. Bloom and others (1956) divided the analysis level into three sub-levels:

1. Analysis of Elements - the student is expected to break down the material into its constituent parts, then identify and classify those parts.

2. Analysis of Relationships - differentiate between various relationships among the elements and determine their connection and inter-action.

3. Analysis of Organizational Principles - the student is able to determine the author's purpose, point of view, attitude, or general conception of a field, in order to better comprehend the meaning of the material.

V. SYNTHESIS

A. Synthesis questions encourage students to think creatively and make original conclusions. It is the ability to put parts and elements together in a form new to the student (Chamberlain and Kelly, 1981).

B. This is the category in the cognitive domain which most clearly provides for creative behavior on the part of the learner; this work is still expected to be within the limits set by particular problem
Synthesis Level (Continued)

theories or method.

C. Bloom and other (1956) have divided the synthesis level into three sub-levels; these levels are distinguished on the basis of the product developed through the synthesis process.

1. Production of a Unique Communication - the student originates a product that produces ideas, feelings, and experiences that are uniquely his/hers; the interpretation should represent the student's individual thinking and personality.

2. Production of a Plan - requires the student to produce a plan or solution to a particular situation.

3. Derivation of a Set of Abstract Relations - requires students to create or derive some type of statement to explain or classify data or a situation. The student can formulate a concept or generalization from the analysis of data.

D. Sanders (1966) has identified various strengths and weaknesses of synthesis questions:

1. Strengths of Synthesis Questions
   a. Allows students great freedom in seeking solutions.
   b. The question has many possible approaches to
Synthesis Level (Continued)

achieve the answer; the student must understand that the teacher does not have a definite answer in mind.

c. The solution requires a product.

2. Weaknesses of Synthesis Questions

a. Asks questions that call for mental creativity, but often may have no correlation with course objectives.

b. There is the possibility of forming questions that are totally beyond the competence of the student.

c. It is difficult to evaluate the answers fairly.

d. It is often difficult to provide conditions favorable for creative work.

VI. EVALUATION

A. Evaluation questions are those requiring the student to make a judgement about something, using some criteria or standard for making the judgement (Clegg, 1967).

B. Bloom makes the point that evaluation is not an activity done after all the other levels of intellectual skills have been used. To some degree, evaluation can be considered a "floating"
Evaluation Level (Continued)

category, in that it can be used at each level of intellectual activity (Hunkins, 1972).

C. Unfortunately, too often only the knowledge level in the cognitive domain is emphasized and evaluated. Students are taught facts and specifics and are then asked to repeat them in various ways (Chamberlain and Kelly, 1981).

D. Bloom and others (1956) have divided the evaluation level into two sub-levels.

1. Evaluation in Terms of Internal Evidence - requires the student to analyze data or conclusions from standpoints such as logical accuracy, consistency, and other internal criteria.

2. Evaluation in Terms of External Criteria - focus is on having students apply known criteria to judge various situations or conditions that he encounters or develops.

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APPENDIX B
LEVELS OF COGNITION DESCRIBED
NEWCOMB-TREFZ MODEL
COGNITIVE LEVELS OF LEARNING

A. Remembering

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

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

B. Processing

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

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

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

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

3. Generally involves the development of some type of product:
   a. a communication that expresses the unique ideas, feelings, and experiences of the student.
   b. a plan or solution to a particular situation.

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

D. Evaluating

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

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

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

TAXONOMY-BASED VOCABULARY LIST

NEWCOMB-TREFZ MODEL
## VOCABULARY USEFUL IN DEVELOPING OBJECTIVES AND TEST ITEMS

### AT VARIOUS COGNITIVE LEVELS

**NEWCOMB-TREFZ MODEL**

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<th>Creating</th>
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Adapted from:

Chamberlain and Kelly (1981); Clegg (1968); Hall (1983)

APPENDIX D

CHARACTERISTICS AND EXAMPLES OF QUESTIONS

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

REMEMBERING

A. Characteristics of the Level

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

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

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

B. Representative Question Types and Sample Questions

1. Completion item
   a. Example – The preferred inventory valuation method for corn in storage on a cash grain farm is

2. Request for a definition, statement of principle, method, or steps of a model.
Remembering Level (continued)

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

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

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

PROCESSING

A. Characteristics of the Level

Students must be able to:

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

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

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

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

B. Representative Question Types and Sample Questions
Processing Level (Continued)

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

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

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

internal temperature of 155 degrees; (e) use dry milk solids

CREATING

A. Characteristics of the Level

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

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

3. The problem, task, or situation involving creating should be new or in some way different from those used in the instruction.

B. Representative Question Types and Sample Questions

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

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

2. Plan an appropriate course of action to a given
Creating Level (Continued)

situation.

a. Example - You have recently been approached by an earthworm producer to help him design an "earthworm harvester." Earthworms are produced in trays of moist compost similar in earthworms must be separated from the compost. Propose a design concept for the earthworm harvester showing sketches, drawings, etc. with sufficient explanation that our earthworm producer (a farmer for 10 years with a high school education) can understand. Prepare a list of information needed to complete your design.

Design criteria: (1) worms must be harvested alive and healthy; (2) at least 95% of the worms are to be recovered; (3) less than 1% of the compost is to be left with the worms; (4) compost is to be saved because it has value as a soil amendment; (5) maximum cost is $10,000 (may be willing to increase for a really promising idea); (6) must be able to harvest one 1'x4'x16' tray in 15 minutes.

Additional information well known to fishermen, little boys, and earthworms: (1) earthworms come to surface of soil during a heavy rain; (2) earthworms go underground if bright light is
Creating Level (Continued)
shown on them; (3) earthworms come to surface if
electric current is introduced into wet soil.

EVALUATING

A. Characteristics of the Level

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

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

B. Representative Question Types and Sample Questions

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

2. Recognize the ways in which the parts of a work fit together in terms of consistency, order, and organization.
   a. Example - Analyze the attached landscape to plan for a front entrance and suggest modifications
Evaluating Level (Continued)

needed, if any.

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

4. Analyze and evaluate a new situation or set of information by relating it to another situation that was previously studied in the course.
   a. Example - Based on what was studied in class for determining feed rations for a cattle herd, what suggestions would you make to the herdsman in terms of the following ration for the following herd specification? (Specifics of ration and herd would be included here.)

5. Establish his/her own criteria to judge a particular situation.
   a. Example - Develop a decision making model for determining the efficacy of using bio-technology procedures to increase milk production.
APPENDIX E

SELECTED SCHOOLS AND TEACHERS
<table>
<thead>
<tr>
<th>District</th>
<th>School</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bowling Green</td>
<td>Mike Shertzer</td>
</tr>
<tr>
<td>2</td>
<td>Lakota</td>
<td>Jeff Adams</td>
</tr>
<tr>
<td>4</td>
<td>Hardin-Northern</td>
<td>Robert McBride</td>
</tr>
<tr>
<td>4</td>
<td>Kenton</td>
<td>Jerry Layman</td>
</tr>
<tr>
<td>5</td>
<td>Coldwater</td>
<td>Dennis Riethman</td>
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<tr>
<td>5</td>
<td>Versailles</td>
<td>Samuel Custer</td>
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<tr>
<td>6</td>
<td>North Union</td>
<td>Nevin Smith</td>
</tr>
<tr>
<td>6</td>
<td>Riverdale</td>
<td>Craig Wiget</td>
</tr>
<tr>
<td>7</td>
<td>Fredricktown</td>
<td>Dan Humphrey</td>
</tr>
<tr>
<td>7</td>
<td>Westfall</td>
<td>Rick Metzger</td>
</tr>
</tbody>
</table>
April 1, 1988

Mike Shertzer
Bowling Green High School
530 West Poe Road
Bowling Green, Ohio 43402

Dear Mike:

Agricultural employers in Ohio recently reported that students graduating from high school, who had previously enrolled in vocational agriculture classes, do not possess the knowledge and skills required for today's agriculture. If the demands of agriculture for the 21st century are to be met, vocational agriculture graduates need to think and respond at higher cognitive levels and teachers of vocational agriculture need to teach at the higher cognitive levels. But, what are the cognitive levels of instruction and student performance from which to begin to develop these higher levels?

As part of a very important study we are planning, we need your help. We do hope you will give us a hand in discovering new knowledge. If you agree to help us, the study will be conducted using your course of study and your twelfth grade students.

An assessment will be done of the course of study to determine at what level of cognition instruction is being delivered to the students based upon the educational objectives written in the course of study. The twelfth grade students will take a paper-pencil test developed by us to measure at what cognitive level the students perform.

This study will not require any labor on your behalf except for the mailing of the course of study to us. We will provide copies of the test, administer the test, and provide postage to cover the cost of mailing the course of study to us.

Your participation in the study is essential for the success of the study. The results of this study will have an impact on vocational agriculture instruction in Ohio.
Your participation will benefit students and teachers today and in the future. You will be contacted by phone in the next few days to determine if you are willing to participate in this study and to answer any questions you may have.

We sincerely appreciate your consideration of this important request.

Thank you,

Jamie Cano, Graduate Student
Department of Agricultural Education

L. H. Newcomb, Professor and Chair
Department of Agricultural Education

JC/
APPENDIX G

DEMOGRAPHIC DATA QUESTIONNAIRE

PRODUCTION AGRICULTURE TEACHERS
DEMOGRAPHIC DATA QUESTIONNAIRE
PRODUCTION AGRICULTURE TEACHERS

Q1 How old are you?
   _______YEARS

Q2 What is your marital status? (Check one)
   _______SINGLE       _______MARRIED       _______DIVORCED

Q3 What is your gender? (Check one)
   _______MALE         _______FEMALE

Q4 How many years have you been teaching?
   _______YEARS

Q5 How many years have you been teaching at this school?
   _______YEARS

Q6 What is the enrollment in your production agriculture class?
   _______STUDENTS

Q7 How many twelfth-grades students are enrolled in your production agriculture classes?
   _______SENIOR STUDENTS

Q8 What is your highest educational degree? (Check one)
   _______HIGH SCHOOL DIPLOMA
   _______TWO YEAR VOCATIONAL DEGREE
   _______BACHELOR'S DEGREE
   _______MASTER'S DEGREE
   _______DOCTOR OF PHILOSOPHY
APPENDIX H

PROCEDURES FOR ADMINISTERING

THE AGRICULTURAL EDUCATION TEST OF

COGNITIVE DEVELOPMENT
PROCEDURES FOR ADMINISTERING THE
AGRICULTURAL EDUCATION TEST OF COGNITIVE DEVELOPMENT

***FOR SENIORS ONLY***

1. There are two parts to the test: TEST I and TEST II. It is recommended that the tests be administered as follows: TEST I TO BE ADMINISTERED ON MAY 23 AND TEST II BE ADMINISTERED ON MAY 24.

2. Students may use calculators.

3. Distribute a copy of the test to each student. TEST I and TEST II have been arranged so that all tests are together for distribution. Ask students not to begin the test until told to do so.

4. Distribute a sheet of colored paper to each student for scratch paper.

5. Read the directions on the first page of the test to the students. Be sure the students have a pencil for use in answering the questions.

6. Tell the students there is no time limit on the test. Urge them to respond to every question.

7. If students have questions while taking the test, respond as you think appropriate. DO NOT, however, provide information which will enable the student to get items correct primarily because you have given additional information.

8. Complete the TEST ADMINISTRATION FORM and the TEACHERS DEMOGRAPHIC DATA QUESTIONNAIRE.

9. Take up the tests when all students have finished.

10. Put TEST I and TEST II, TEST ADMINISTRATION FORM, and the TEACHERS DEMOGRAPHIC QUESTIONNAIRE in the stamped and addressed envelopes and mail immediately. Scratch paper may be thrown away.

THANK YOU
APPENDIX I

CONTENT VALIDITY PANEL
CONTENT VALIDITY PANEL

Teacher Educators

Dr. Kirby Barrick
208 Agriculture Administration Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 43210

Dr. James Knight
208 Agriculture Administration Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 43210

Dr. J. David McCracken
203 Agriculture Administration Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 43210

Former Vocational Agriculture Teachers

Mr. Mathew Baker
246 Agriculture Administration Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 43210

Mr. Harry Boone
212 Agriculture Administratif Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 43210

Mr. David Doerfert
201 Agriculture Administration Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 43210
Mr. Jack Elliot
207 Agriculture Administration Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 43210

Mr. Charles Miller
246 Agriculture Administration Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 4321

Ms. Susie Whittington
212 Agriculture Administration Building
2120 Fyffe Road
The Ohio State University
Columbus, Ohio 43210
APPENDIX J

TEST ADMINISTRATION FORM
TEST I ADMINISTRATION FORM

DATE TEST ADMINISTERED: ________________________________

NUMBER OF STUDENTS PRESENT: ____________________________

NUMBER OF STUDENTS ABSENT: _____________________________

TIME TEST STARTED: ____________________________________

TIME TEST ENDED: ______________________________________

INSTRUCTORS SIGNATURE: ________________________________
TEST II ADMINISTRATION FORM

DATE TEST ADMINISTERED: ____________________________

NUMBER OF STUDENTS PRESENT: _______________________

NUMBER OF STUDENTS ABSENT: _________________________

TIME TEST STARTED: ________________________________

TIME TEST ENDED: _________________________________

INSTRUCTORS SIGNATURE: ___________________________
APPENDIX K

AGRICULTURAL EDUCATION TEST

OF COGNITIVE DEVELOPMENT
AGRICULTURAL EDUCATION TEST OF COGNITIVE DEVELOPMENT

TEST I

DIRECTIONS TO STUDENTS

1. Answers to all questions on this test are to be circled directly on the test booklet.

2. Do not tear any of the pages. Scratch paper is furnished for your calculations.

3. Do not open this test until you are told to do so.

4. Follow all instructions given by your teacher.

5. How to use the test booklet.

EXAMPLE:

Step A. Read the question

1. Chicago is a:
   a. country
   b. mountain
   c. peninsula
   d. city

Step B. Select the answer and circle the corresponding letter on the test booklet. If more than one answer seems correct, select the MOST correct. For this question you would circle the letter "d" as shown in this sample.

6. Circle each appropriate letter completely, but do not allow the circles to extend beyond the intended letter. Erase all errors carefully and completely. Circle only ONE letter for each question.

7. Do not spend too much time on questions which seem difficult. Continue working on the test, and if time is available, return to the unanswered questions. Check your work after completing the test. Attempt to answer EACH question.
1. Including this year, how many years of vocational agriculture have you had:
   a. one year
   b. two years
   c. three years
   d. four years

2. The largest source of information for farm related jobs would be found:
   a. at an employment agency
   b. in local newspapers
   c. in farm magazines
   d. from civil-service listings

3. During your local FFA banquet, you are given the responsibility of introducing the State FFA President as the banquet speaker. Using 25 words or less, which one of the following statements would you use?
   a. It is my pleasure to introduce John Smith our State FFA President. John lives in Columbus and attended Columbus High School.
   b. With great pleasure I introduce to you your State FFA President, Mr. John Smith. John's parents are Mr. and Mrs. Jim Smith.
   c. Bringing a message from the State FFA Association is President John Smith. John attended Columbus High School and is a sophomore at Ohio State.
   d. Here to speak at our banquet is John Smith the current State FFA President from Columbus. John goes to college and attended Columbus High School.

4. A common respiratory disease when young beef are sold and trucked to new locations is:
   a. trucking fever
   b. respiratory fever
   c. shipping fever
   d. young fever
5. You have just placed a crossbred steer class 4-3-2-1. You have to write a set of reasons for your teacher defending your placement. Which one of the following sets of reasons would you select?

a. I placed these crossbred steers 4-3-2-1. I considered 4 a placeable top as he best combined size, muscling, and correctness of finish; however, I would like to see him stronger over his top.

In my top pair I preferred 4 over 3, as 4 was taller and longer than 3. Furthermore, 4 was trimmer, firmer handling steer that would hang up a heavier-muscled, higher quality carcass. I will grant 3 was a straighter lined steer that was flat in his quarter.

In my middle pair I placed 3 over 2. Three was a nicer balanced, stretchier steer, standing on more substance of bone and was deeper ribbed than 2. I will concede that 2 was a wider standing, heavier muscled steer, but I criticized him as he was a heavy fronted, patchy finished steer that was too small.

In moving to my bottom pair, I liked 2 over 1, as 2 was the thickest topped, heaviest quartered steer in the class. I placed 1 last as he was a small framed, light muscled steer that was bare over the ribs.

b. I placed this class of crossbred steers 4-3-2-1. I placed 4 on top of the class because he was the largest steer in the class. Also, I like the way 4 was able to stand on more substance of bone. However, I fault 4 for not having the straightness over the top desired.

I placed 4 over 3 because 4 was bigger and had more bone than 3. Three did have more muscling than 4 however. Four seemed to have a better disposition than 3.

I placed 3 over 2 because 2 looked like a wasty steer. Although 2 was bigger than 3, 2 did not have the amount of muscles that was evident in 3. I put 3 second because the steer had straighter top and was a stretchier steer.

Finally, I put 2 over 1 because 1 was the lightest muscled steer in the class. Two was stronger than 1 and had a much better finish than 1.

c. I placed these steers 4-3-2-1. I put 4 first because he was the biggest steer in the class. I put 3 second because he was straighter lined and was flat in his quarter. But 4 did seem to be a firmer
handling animal.

I put 2 third because he was a wider standing steer and was heavier muscled, but he did not finished very good.

I put 1 last because he was the smallest in the class, was light muscled, and was bare over the ribs.

d. I placed this class of steers 4-3-2-1. In my top pair I placed 4 over 3 because 4 was taller and longer. Also, 4 was trimmer and easier to handle. Although 3 was a straighter lined steer, he was flat in the quarters.

In my middle pair I put 3 over 2 because 3 was nicer balanced and was deeper ribbed. Granted that 2 was a wider standing steer, but he was too heavy fronted.

In my bottom pair I put 2 over 1. I liked 2 better than 1 because 2 was thicked topped and the heaviest steer in the class. One was placed last because he was a small and light framed steer.

6. The quality of T-bone steak can best be determined by the steak's:
   a. age
   b. size
   c. marbling
   d. thickness

7. You have been asked to plan a good ration for the sows for use during the breeding season. Which one of the following would you select to use?
   
a. First you would consider the age and condition of the sows to be fed. Thin sows require more feed than do sows in good flesh. Large sows need more feed than do small sows and young sows must have more feed per hundred pounds of live weight than most mature cows. The stage of pregnancy must also be considered.

   b. You would feed all the sows the same amount of feed. Being that all the sows are kept in one large pen, the amount of feed each would receive would be the same for all the sows. The plan here would be to ensure that enough feed was put in the troughs so that every sow would eat approximately four pounds of feed per day.

   c. In addition to the considerations in "a" above, a balanced ration consisting of 8.9% ground yellow corn, 44% solvent soybean meal, 17% dehydrated alfalfa meal,
and 50% meat, bone meal, and minerals would be fed. Also, the sows would be separated to ensure that each sow would receive the recommended amount of feed.

d. The plan would be that the sows would be fed by hand the right amounts of feed daily or self-fed a bulky ration. The self-feeding method requires less labor, and hand-feeding usually takes less feed.

8. The general shape and arrangement of the parts of a livestock animal's body is referred to as:

a. conformation
b. carcass yield
c. breed characteristics
d. cutability

9. As part of your SOEP you have decided to raise breeding swine. Part of the equipment necessary is a farrowing crate. Design an economical farrowing crate which contains the following essential features: 3 feet wide; 6 feet long, pig creep in the front, waterer, and located in the middle of the hog pen. Which one of the following designs best fits the needs as described?

a. 

b. 

c. 

d.
10. One of the most common sheep diseases is:
   a. pinkeye
   b. foot rot
   c. wool maggots
   d. day blindness

11. Your boss at the Co-op has asked you to formulate a ration for cattle that are intended to make Choice grade. Which one of the following rations would you select as the best possible for cattle that are intended to make Choice grade and weighing 1000 pounds?
   a. Legume hay: 1/4 pound per cwt. live weight, daily
      Legume grass silage: 2 pounds per cwt. live weight, daily
      Ground sorghum grain: full feed
      Corn: 15-25 pounds daily
      Protein meal or 30 - 35% protein commercial supplement: 1 pound daily
   
   b. Legume hay: full feed
      Minerals: free choice
      Legume grass silage: 15-25 pounds daily
      Corn: 2-3 pounds daily
   
   c. Ground corncobs: 10-14 pounds daily
      Purdue Supplement A: 3-3.5 pounds daily
   
   d. Grass hay: 1/2 pound per cwt. live weight, daily
      Sorghum or corn silage: 2 pounds per cwt. live weight, daily
      Corn or sorghum grain: Free choice
      Purdue Supplement A: 5 pounds daily

12. Plastic ear tags should be used in identifying hogs because they are:
   a. cheaper than other methods
   b. required for breed registration
   c. a permanent identification
   d. more visible than other marking systems

13. John has decided to raise lambs in an effort to make some money to buy a car. During the first year, John did very well and made enough profit for a down payment on his new car. However, this luck did not carry over into the next year because of an unusually high mortality rate among his ewes. John had to develop a plan for raising orphaned lambs
if he was to continue making his car payments. Which of the following plans would you recommend for John to use?

a. Try to graft the orphaned lambs with other ewes.

b. Visit your local dairy farmer and purchase fresh cow milk for the lambs. The lambs will have to be hand fed with bottles at first. This milk should be warmed up to 98 °F prior to the feeding. Because this is not milk from the ewe, the lamb should be allowed to drink all the milk it wants. Slowly increase the amount of milk and increase the feeding intervals as the lamb grows stronger.

c. The lambs will have to be hand fed. The lamb should be fed two or three feeds of colostrum, or first milk, either from the mother or another ewe by milking the ewe and using a bottle to feed the lamb. The milk should be warmed to 98 °F before feeding. For the first day or so, one ounce fed at two-hour intervals is sufficient. Later, the amount may be slowly increased and the feeding intervals spread further apart.

d. both a and c

14. The most valuable per pound wholesale cut of the market hog is the:

a. shoulder
b. side
c. loin
d. bacon

15. On dairy farms where production costs are high and the product is sold as whole milk, many dairymen are turning to milk replacers as a means of lowering the cost of raising young stock. The successful raising of calves on milk replacers depends very largely upon how complete and nutritionally the product is. Your task is to create a milk replacer that is complete and nutritional. Which one of the following formulas is the most nutritional and complete?

a. Dried skim milk: 40%
   Dried Whey: 8.5%
   Distillers dried solubles: 15%
   Oat flour: 5%
   Blood flour: 10%
   Dextrose: 7%
Fat: 12%
Vitamin A supplement: 1%
Minerals: 1%
Antibiotic feed supplement: .5%

b. Dried skim milk: 98%
Vitamin A supplement: 1%
Minerals: 1%

c. Dried skim milk: 62%
Dried buttermilk: 25%
Fat: 12%
Vitamin A supplement: 1%

d. a, b, or c

16. When applying post-emergence herbicide to soybeans, a farmer would spray:

a. before noon
b. before planting
c. after crop is up
d. after harvesting

17. You have two dwarf apple trees which were planted at the same time and were acquired from the same grower. The trees are now seven years old. One tree has flowered and set fruit regularly; the other tree has yet to flower. Which one of the following would you recommend to do?

a. Dig up the tree that has not set fruit and replace that tree with a new dwarf apple tree.

b. Do an analysis of the soil where the tree which has not set fruit is planted and also of the soil where the tree which has fruit is planted. After the analysis has been conducted, try to equate the soil composition.

c. Try to girdle the tree which has not set fruit by using a piece of baling wire. Tree growers have always known that by girdling a tree, the tree will set fruit at an earlier age or will increase the fruit production of the tree.

d. Call your Extension Horticultural Specialist and invite him/her over to your house to make a diagnosis of the problem with the tree.
18. When growing soybeans, a rotary hoe is used mainly to:
   a. break crust
   b. take out large weeds
   c. incorporate seed
   d. incorporate insecticide

19. John wants to plant a maple tree in his backyard. Since John needs more shade in the backyard, the best place to plant the tree is approximately four feet from the concrete patio. John is concerned with the root development of the tree in future years, especially if the roots grow under the patio and crack the concrete. Which one of the following would you recommend to John to do?
   a. Plant the tree deeper than usual to encourage deeper root growth.
   b. Prune the limbs on the patio side of the tree to control root growth.
   c. Use systemic herbicides to control root growth on the patio side of the tree.
   d. Encourage deeper root growth through appropriate watering and fertilization.

20. Over threshing of grain can be determined by:
   a. cracked grain in grain tank
   b. beans left in bean pods
   c. beans laying on ground behind combine
   d. bean pods and small stems in grain tank

21. Last spring Joann had the responsibility of taking care of a home vegetable garden. Joann used the 15-15-10 fertilizer which her parents bought the previous year. Joann followed the directions on the bag which indicate that 5 pounds of fertilizer is required for every 1000 square feet of garden. Joann applied all the required amount of fertilizer in one application at the beginning of the growing season.

   In addition to the usual rainfall in Ohio, Joann used a sprinkler to water her garden once a week. Disease was not a problem in the garden last year. However, the vegetable production was not good.

   Based on the above information, which plan would you recommend to Joann to improve her vegetable production next year?
a. Use compost materials to increase the organic content of the soil.

b. Split the required amount of fertilizer in two halves and apply each half six weeks apart.

c. Have the soil tested before planting and follow the recommendation from the results.

d. Increase the amount of fertilizer suggested on the directions on the bag.

22. Any farmer can purchase and use pesticides classified for:

   a. general use
   b. restricted use
   c. commercial use
   d. industrial use

23. Last winter you planted a dwarf apple tree in your back yard. While playing football, you ran into the young tree and broke off the central leader. The problem now is what to do with the broken tree. Which one of the following would you recommend?

   a. Dig out the tree and plant a new one in its place.

   b. Prune whatever branches may remain and hope new branches grow in their place.

   c. Leave the tree alone. Do not do anything with it because it is common knowledge that a new central leader always grows when the original central leader is broken.

   d. Plant another dwarf apple tree next to the broken one and when the second tree is large enough, remove the original tree.

24. Herbicide compatibility refers to the relative:

   a. effectiveness of weed control
   b. danger of personal injury because of skin contact
   c. time period needed to be effective
   d. ease of mixing different herbicides
25. You have been hired to design and plant a landscape for a private home owner. In your visit with the family you find that they enjoy their privacy year round. Instead of having a fence, they wish to have screening plants placed along the back of the lot. You also find that there is no problem of high winds in the area. As with all new home owners, they are anxious for a complete landscape but know that the cost of materials may restrict their desires. Based on your survey the following plants are needed: 10 deciduous shrubs (final height 3 feet), 3 deciduous trees (final height 20 feet), 5 evergreen shrubs (final height 8 feet), and 10 evergreen trees (final height 30 feet). How would you design the landscape plan?

26. For proper storage, shelled corn should be dried to:

a. 8.5% moisture
b. 10.5% moisture
c. 15.5% moisture
d. 17.5% moisture
27. A local farmer you work for has approached you about a unique problem he needs help with. In his prized corn field (the corn is 2 feet tall at this time), there are is a 25 foot wide strip of land on which corn is planted that is heavily infested with weeds. The remaining acreage in the 20 acre field is weed free. The farmer has asked to devise a plan by which to get rid of the weeds. Which one of the following plans would you recommend?

a. Purchase a gallon of Round-up and following the directions from the manufacturer, mix the proper amount and spray the weeds in the corn field with a portable hand sprayer.

b. Using a hoe, go into the corn field and manually chop down the weeds in the prized corn field.

c. Because the corn is still small, leave the weeds alone. Eventually the corn will grow tall and the weeds will disappear from the sight of the public.

d. Using the tractor and the proper implement, go into the field and carefully try to work around the existing corn plants and try to get rid of the weeds.

28. The combine part responsible for most field loss in soybeans is the:

a. grain tank
b. unloading auger
c. cutting bar
d. stock chopper

29. While mowing the lawn, you stopped to check the air cleaner because it looked dirty. In the process of removing the air cleaner, you accidently broke off the bracket which holds the air cleaner in place. It is very important that you finish mowing the lawn for your upcoming graduation party. The problem is how to finish mowing the lawn with a broken air cleaner bracket. Which one of the following would be most appropriate for you to do?

a. Go and buy a new lawn mower.

b. Use baling wire to tie the broken bracket as firm as possible to continue mowing.
c. Use super glue to glue the broken bracket back in place

d. Continue mowing the grass without the air cleaner in place.

30. The electric current is disrupted in the primary circuit on a small engine by the:

a. spark plug  
b. magnet  
c. coil  
d. breaker point

31. The gate to the livestock pens has been giving you a lot of problems. The major problem is that the gate sags and is difficult to open, close, and secure. After checking the posts which support the gate, you find them to be snug into the ground. You decided to correct the sagging problem. Which one of following would you do?

a. Remove the hinges and replace the hinges with larger hinges in a different location.

b. Leave the hinges as they are and brace the gate to take care of the sagging problem.

c. Attach a wheel at the bottom of the gate to avoid the dragging.

d. both b and c.

32. Before sawing lumber with a table saw, lumber should be checked for warps, knots, and:

a. texture  
b. stains  
c. nails  
d. grade

33. While servicing your tractor, you drained all the oil. You proceeded to remove the oil filter and the oil filter was too tight and wouldn't come off. Which one of the following would you do?
a. Put new oil back into the engine and forget about removing the oil filter.

b. Using a long screwdriver, drive the screwdriver through the oil filter and use the screwdriver as a lever to loosen the tight oil filter.

c. Using a large pipe wrench, try to unscrew the tight oil filter.

d. Using a hammer, tap the tight oil filter to see if you can loosen it that way.

34. When arc welding, proper speed is determined by the thickness of the metal and:

a. time available
b. amperage setting
c. length of bead
d. length of arc

35. After driving your truck at night you noticed that the headlights were dimmer than usual. Upon further inspection, you find the alternator belt loose. To tighten the alternator belt, you need to loosen the bolts on the alternator bracket. When you tried to loosen the bolts on the alternator bracket, you found one of the bolts to be too tight. Which one of the following would you do?

a. Using an oxy-acetylene torch, heat up the tight bolt hoping the bolt will loosen.

b. Spray some WD-40 on the tight bolt, wait a few minutes, and try to loosen the bolt.

c. Using a ball-pein hammer and the proper size box-end wrench, tap the wrench with the hammer to loosen the tight bolt.

d. Using a tap and die set, drill into the tight bolt and then tap out the tight bolt.
36. Materials such as sand, gravel, crushed rock and cinders are called:
   a. aggregates
   b. cement
   c. concrete
   d. mortar

37. While calibrating a sprayer, you realized that the proper size nozzle tip was not available. The only size tip available was larger than the recommended size. While searching for the proper size nozzle you found some smaller diameter hose. Because weather and plant conditions are excellent for spraying today, you try to find an alternative to the over-sized nozzle. Which one of the following would you recommend?
   a. Attach the over-sized nozzle and spray.
   b. Using some string, try to constrict or reduce the flow of the chemical before the chemical reaches the nozzle.
   c. Replace the hose on the sprayer with the smaller diameter hose found earlier.
   d. Not spray at all and wait until you are able to find the appropriate nozzle size.

38. A hydraulic pump creates:
   a. heat
   b. vacuum
   c. flow
   d. pressure

39. During the recent ice storm a large tree branch broke and got caught in other branches 30 feet in the air. Due to the location of the broken branch and the threat of it falling and damaging the patio, the broken branch must be removed. The highest ladder you have available is a 10 foot step ladder. Which one of the following would you do?
   a. Ignore the threat and leave the broken branch in the tree.
b. Call a tree limb removal company which will charge approximately $100 to remove the branch.

c. Using several good strong ropes, climb the tree and tie the broken branch with the ropes and attempt to lower the branch slowly.

d. Using a hand saw, climb the tree and cut the broken branch in several places and then lower the smaller branches with the ropes.

40. A condenser on a small engine:

a. stores electricity in the primary circuit
b. produces voltage in the secondary circuit
c. is not found in the primary circuit
d. reduces voltage in the secondary circuit

41. After purchasing a personal computer system for farm use, you set up the system at home. After all cables are connected, you plug the system into the household electrical outlet using a three prong adapter. Because you live in an older farm home, the ground system is not built into your electrical system. Therefore, in order to plug your computer into the electrical system you had to use an adapter which reduces the standard three prong plug found on personal computer systems to a two prong plug which is available in your home.

You proceed to turn on the system and nothing works. After consulting with the service department in the store where you bought the computer, you learn that you must have a grounded electrical system for the computer to operate. Determined to make the computer system work, which one of the following would you do?

a. Call an electrician to come and rewire the entire house to include a grounded electrical system.

b. Using a heavy gauge of electrical wire, you run the electrical wire from the outlet in the room to a metal steak which is driven into the ground outside the room which the computer will be used. By securing the wire at both ends, you are able to ground the computer system.
c. Without adding more wires, remove the two prong outlets where the computer was to be plugged in and replace it with a three prong outlet.

d. Replace the cord on the computer with a standard two prong cord.

42. Wheel bearing lubricant for a tractor should be:
   a. high melting point grease
   b. low melting point grease
   c. 10W - 40W oil
   d. hydraulic fluid

43. With the threat of a rainstorm evident, it is critical that you finish baling hay. However, while out in the field baling some problems develop. The hydraulic hose from the tractor to the baler is leaking severely and the tractor just doesn't seem to be running right. The only tools you have with you on the tractor are an adjustable wrench, hammer, a couple screwdrivers, and black tape. After further inspection, you learn that the leak is at the point where the coupling is connected to the hose. The problem with the engine on the tractor you cannot diagnose precisely, but you suspect it has something to do with the timing. Which one of the following would you recommend to do?

   a. Quit and go home. Let it rain and then in the next few days go out and turn the alfalfa hay so it will dry completely. Bale the hay only after the hydraulic hose has been replaced and the engine checked out.

   b. Continue baling for as long as you can. Continue monitoring the hydraulic fluid level. If the tractor engine does not quit before the hydraulic fluid runs out, continue baling. If the hydraulic fluid gets critically low, stop baling and go home. Take care of the problems and in a few days continue to bale the hay.

   c. Because you have some tools with you and black tape, attempt to correct the problems in the field. First take the black tape and wrap it tightly around the hydraulic hose. Using a screwdriver, remove the distributor cap on the engine and attempt to adjust the timing yourself. Continue baling and hope all goes well.
44. When a mixture of oxygen and acetylene is varied to give an excess of oxygen, the resulting flame is called:

a. neutral  
b. oxidizing  
c. carburizing  
d. reducing

45. You are feeding 100 steers in a climate where the winter temperature is below 20 F for 35 days each winter. It is below 10 F 10 days and below 0 F 5 days. You are watering in a concrete trough that is 20 feet long, 2 1/2 feet wide, and 3 feet deep. It is located outside. A power source is nearby. Which of the following methods of insuring fresh water daily year round is most cost effective?

a. Mechanically remove ice with sledge hammer and shovel and refill the waterer twice daily. The required labor per day that this is done is 4 hours.

b. Install 3 extra troughs to be filled with water as each one freezes. Cost of troughs and installation is $1600.00.

c. Install a thermostatically controlled submersible heater in the trough. Cost of heater is $150; installation cost is $110; annual cost of electricity to operate is $21.75.

d. Add one pound of salt per 100 gallons of water to lower freezing point.

46. The most important management tool for a dairy farmer is:

a. production records  
b. income records  
c. health records  
d. tax records

47. Because of the high cost of milk production, you need to reduce your dairy herd from 100 cows to 75 cows. Which one of the following plans would be best?

a. On the onset, get rid of the 25 oldest cows regardless of their milk production. Some of these cows may still be able to produce milk for two or three years more.

b. By a careful analysis of the production records of each cow, select the 25 cows which have the poorest production record. Even though some of these cows are poor milk producers, they may be some of the best breeding
stock you have ever had.

c. Review the entire DHIA records and ascertain which of the cows have a family history of not being good milk producers or good breeding stock. After you have carefully selected the cows which are not very good, and you have not yet reached the required number of twenty five, follow the recommendation in "b" above.

d. Call your local veterinarian to come by and run a health check on each cow to determine which ones are in the worst physical condition. Replace the 25 cows which end up having the worst physical condition.

48. In a record book, the item "sold 3 calves for $100 each" would be entered as:

a. a "cost" factor
b. an "income" factor
c. an item in the inventory
d. a depreciation item

49. In order to increase profitability, farmers need to pay most attention to:

a. marketing of products, both at the local level and at the national level.

b. the cost of production. This cost must not be over 33% of the total value the farmer will receive at market.

c. the cultural practices of other farmers around him who are successful. Many times farmers are able to learn a lot from other farmers and thus can increase the profitability.

d. the time required to produce a unit of return. In other words, the farmers need to pay close attention to the amount of time that is devoted to the growing of crops.
50. Which of the following is the best proof of purchase for a farmer's record system?

a. cancelled check
b. original invoice
c. cash register receipt
d. the purchased item

51. You are deciding whether to plant 100 acres of corn and 100 acres of soybeans, some other combination of the two, or whether to devote 100 acres to a new specialty crop. In making your decision, which one of the following factors would be most important?

a. Before making any sensible decision, you must study the market trends of all the crops which are potential for planting. You must also call a broker and find out what the future looks like for the crops you might want to pant.

b. A more in depth look at the specialty crop is necessary. You must talk to others who have planted the crop in the past and learn what success or failure came with that crop. Of most importance is, will there be a market for this crop?

c. Would it be more feasible to plant 200 acres of one crop? Again, the price of the production and the value of the crop at harvest are important to consider. Is there going to be a demand for the product?

d. Be a true experimenter and plant the specialty crop and a combination of corn and soybeans. Let the market dictate the price and if nothing else, you have learned a lesson of what to do and what not to do next year.

THIS IS THE END OF TEST I

THANK YOU
LIST OF REFERENCES
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