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The relationship between agriculture teachers' learning style and problem-solving ability and the extent of use of the problem-solving approach to teaching

Garton, Bryan Luke, Ph.D.
The Ohio State University, 1993
THE RELATIONSHIP BETWEEN AGRICULTURE TEACHERS' LEARNING STYLE AND PROBLEM-SOLVING ABILITY AND THE EXTENT OF USE OF THE PROBLEM-SOLVING APPROACH TO TEACHING

DISSERTATION

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

by


*****

The Ohio State University

1993

Dissertation Committee:

Dr. Jamie Cano
Dr. R. Kirby Barrick
Dr. J. Robert Warmbrod

Approved by

Adviser
Department of Agricultural Education
To my wife, Deborah, and son Joshua Tyler,
I dedicate this work.
ACKNOWLEDGEMENTS

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CHAPTER I
INTRODUCTION

Background

Problem-Solving Approach

The problem-solving approach to teaching has had a long history in the agricultural education profession (Moore & Moore, 1984; Lass & Moss, 1987; Herren, 1987). Dickerson (1984) maintained that "the problem-solving approach to teaching has become almost synonymous with agricultural education" (p. 6). Long (1983) added that "problem solving has long been of concern in vocational agriculture instruction as well as in overall education" (p. 5).

Educators in the agricultural education profession have promoted the problem-solving approach to teaching as the most effective approach for teaching secondary agriculture students (Martin, 1982; Osborne & Hamzah, 1989). Newcomb (1982) concluded that "the reason agricultural educators are enamored with problem solving teaching is because it works so well" (p. 9). Phipps (1980) provided the following rationale for the use of the problem-solving approach in teaching secondary agriculture students:
The problem solving procedure is recognized as being an effective means of developing and securing desirable learning. It stimulates interest; develops thinking ability; and helps students to evaluate, draw inferences from, and make decisions essential to the solution of a problem. It is usually conceded that facts gathered because they are necessary to the solution of a problem are more permanently learned. Problem solving provides abundant opportunities to draw inferences from data. No amount of learning of facts for future use can provide this type of experience. Problem solving provides opportunities for thinking and people learn what they do. (p. 48)

Recently the agricultural education profession placed an emphasis on teaching secondary agriculture students decision making skills through problem-solving (American Association for Agricultural Education, Preparation of Professionals for Agricultural Education, 1991). Furthermore, Crunkilton (1988) concluded that "... problem solving, both as a method of teaching and as a skill that students need, is more critical today than it was years ago" (p. 8). However, problem-solving as a basic skill or an approach to teaching is not a new concept in education.

Textbooks on the subject of teaching agriculture have long advocated the teaching of agriculture through the

With the emphasis placed on teaching secondary agriculture students through the problem-solving approach, the question arises as to what extent do teachers of agriculture teach using the problem-solving approach? Furthermore, do teachers of agriculture possess the characteristics to teach utilizing the problem-solving approach?

Mosston (1972), in discussing problem-solving, stated that "problem solving as a teaching style requires problem solving as a learning style" (p. 166). What are learning styles and what potential influence does a person's learning style have on the extent he/she utilizes the problem-solving approach to teaching?

**Learning Style**

Learning style describes the manner in which learners sort and process information. Researchers (Witkin, 1973; Gregorc, 1979; Garger & Guild, 1984) have suggested that learning styles were an important factor in several areas
including students' academic achievement, how students learn and teachers teach, and student-teacher interaction. Dunn and Dunn (1979) stated that "there is a commonly ascribed-to belief that 'teachers teach the way they were taught'" (p. 241). However, Dunn and Dunn (1979) perceived a more accurate statement should be that "teachers teach the way they learned" (p. 241). In a study of elementary teachers, Lyons (1984) concluded that teachers' learning style had an influence on the way teachers taught. But, how has a person's learning style been studied?

The most extensively studied learning style dimension has been field-dependence and field-independence and has produced the broadest applications to educational problems in the last 50 years (Guild & Garger, 1985). Research (Witkin, 1973) has shown that a person whose mode of perception was strongly dominated by the surrounding field was said to be leaning toward a field-dependent learning style. Individuals with a field-dependent learning style tend to perceive the world globally, find it more difficult to solve problems (Ronning, McCurdy, & Ballinger, 1984) and find it more difficult to teach using a problem-solving approach (Witkin, Moore, Goodenough, & Cox, 1977).

A person who perceives items as more or less separate from the surrounding field is leaning more toward a field-independent learning style. Field-independent learners view the world more analytically, find it easier to solve problems
(Ronning, McCurdy, & Ballinger, 1984) and have less difficulty in teaching using an inquiry or problem-solving approach (Garger & Guild, 1984).

Studies have been conducted in the agricultural education profession to access the learning styles of secondary agriculture students (Howard & Yoder, 1987; Rollins, Miller, & Kahler, 1988), agriculture teacher educators and state supervisors (Foster & Horner, 1985), and preservice teachers of agriculture (Cano, Garton, & Raven, 1991; Cano & Garton, 1992). In addition, studies in agricultural education have been conducted to assess the teaching styles of teachers of agriculture (Barrett, 1991) and preservice teachers of agriculture (Cano, Garton, & Raven, 1991; Cano & Garton, 1992).

Research has been conducted in several teacher education disciplines with regard to the relationship between teachers' learning styles and teaching styles (Ekstrom, 1976; Koppleman, 1980; Mahlios, 1981; Lyons, 1983; Lyons, 1984). However, research is lacking in the agricultural education profession that identifies the relationship between agriculture teachers' learning and teaching styles. More specifically, with the emphasis that has been placed on teaching using a problem-solving approach to teaching (ATE, 1991; AAAE, 1991), research is needed that identifies the relationship between a teacher's learning style and the extent that he/she teaches utilizing the problem-solving approach to teaching.
Problem Statement

In the agriculture teacher preparation program at The Ohio State University, preservice teachers receive extensive instruction and practice in the use of the problem-solving approach to teaching. The "Methods of Teaching Agriculture" course, Agricultural Education 530, prepares prospective teachers of agriculture in developing lesson plans and teaching utilizing the problem-solving approach to teaching (Appendix A).

However, in a study of Ohio agriculture teachers, Boone and Newcomb (1990) found little difference between agriculture teachers' use of the problem-solving approach to teaching and use of a subject-matter approach to teaching. Boone and Newcomb (1990) defined the subject matter approach to teaching as:

". . . a teacher-centered approach to teaching where students are more passive participants in the learning process. Students listen to the information, participate in limited discussion, take notes, and retrieve or recall the information for evaluation purposes. With the subject matter approach the focus is more on acquisition of information than on group driven problem solving." (p. 9)

In addition, McKee (1991) concluded that the student teaching practicum was not developing the student teachers'
ability to use the problem-solving approach to teaching. But, neither Boone and Newcomb (1990) or McKee (1991) provided evidence to the extent agriculture teachers utilized the problem-solving approach to teaching.

Despite the instruction received by preservice teachers to teach utilizing the problem-solving approach, a problem exists in that there is a lack of evidence that identifies the extent to which student teachers and cooperating teachers utilize the problem-solving approach to teaching during the student teaching practicum. Furthermore, there is a paucity of information regarding the relationships between agriculture teachers' learning style and problem-solving ability and the extent they teach using the problem-solving approach.

**Purpose of the Study**

The purpose of the study was to test the hypothesized relationships between student teachers' preferred learning styles and problem-solving ability and the extent of use of the problem-solving approach to teaching during the student teaching practicum. The study further sought to test the hypothesized relationship between the extent cooperating teachers utilized the problem-solving approach to teaching and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. In addition, the study sought to describe the teaching methods utilized, by student and cooperating teachers, while using and not using the problem-solving approach to teaching during the
student teaching practicum. To guide the study the following research hypotheses and objectives were developed:

**Research Hypotheses of the Study**

1. The more field-independent the student teachers' learning style, the greater their problem-solving ability.
2. The more field-independent the student teachers' learning style, the greater their extent of use of the problem-solving approach to teaching during the student teaching practicum.
3. The greater the extent cooperating teachers utilize the problem-solving approach to teaching, the greater the extent student teachers utilize the problem-solving approach to teaching during the student teaching practicum.

**Objectives of the Study**

1. To describe the teaching methods utilized by student teachers, while using the problem-solving approach to teaching.
2. To describe the teaching methods utilized by student teachers, while not using the problem-solving approach to teaching.
3. To describe the teaching methods utilized by cooperating teachers, while using the problem-solving approach to teaching.
4. To describe the teaching methods utilized by cooperating teachers, while not using the problem-solving approach to teaching.

Definition of Terms

Learning Style

A person's learning style has been defined as "distinctive behaviors which serve as indicators of how a person learns and adapts to his/her environment. It [learning style] also gives clues as to how a person's mind operates" (Gregorc, 1979, p. 234). Garger and Guild (1984) further defined a person's learning style as "stable and pervasive characteristics of an individual, expressed through the interaction of one's behaviors and personality as one approaches a learning task" (p. 11).

The most widely studied learning style has been the field-dependence/independence dimension (Kirby, 1979; Guild & Garger, 1985) and has produced the broadest applications to educational problems (Witkin, Moore, Goodenough, & Cox, 1977). Research (Witkin, Moore, Goodenough, & Cox, 1977) has shown that a person whose mode of perception was strongly dominated by the surrounding field was said to be leaning towards a field-dependent learning style. Conversely, research (Witkin, Moore, Goodenough, & Cox, 1977) has found that a person who perceived items as more or less separate from the surrounding field leaned more toward a field-independent learning style.
For the purpose of the study, an individual's learning style was operationally defined as field-dependent or field-independent. Field-dependence and field-independence was determined by an individual's score on the Group Embedded Figures Test (GEFT) (Oltman, Raskin, & Witkin, 1971).

**Problem-Solving Ability**

Lancelot (1944) attributed a person's ability to solve problems to his/her "general thinking ability." Sternberg and Baron (1985) provided the connection between problem-solving and critical thinking by stating that critical thinking skills included the abilities to "define and clarify, judge information, infer-solve problems, and draw reasonable conclusions" (p. 42).

Kolesnik (1964) and de Bono (1984) noted that critical thinking was a component of problem-solving. Therefore, in the process of solving problems a person was required to use critical thinking skills (Lancelot, 1944). Kolesnik (1964) added that "in the same way that critical thinking involves reasoning, so does problem-solving include critical thinking" (p. 235).

Others (Kitchener, 1983; Quellmalz, 1985) have viewed critical thinking as almost synonymous with problem-solving. Chuatong (1986) noted that there was an overlapping core of cognitive skills which were basic and manifested in critical thinking and problem-solving.
For the purpose of the study, an individual's problem-solving ability was operationally defined as the subjects score on the Cornell Critical Thinking Test, Level Z (Ennis & Millman, 1985). The Cornell Critical Thinking Test, Level Z (Ennis & Millman, 1985), is a 52-item multiple choice test intended to be taken within a 50-minute period (Ennis, Millman, & Tomko, 1985).

Extent of Use of the Problem-Solving Approach To Teaching

Martin (1982) stated that problem-solving "...is thinking, gathering information, testing ideas and procedures, making decisions, and acting upon these decisions by developing further the technical skills needed to solve the problem" (p. 14). Cole (1982) stated that "in order to effectively utilize the problem-solving approach, the problem must be concisely identified, the various kinds of facts and detailed information appropriate to the solution of the problem must be identified and gathered, and the facts and details must be put into a problem-solving format appropriate to the type of problem under consideration" (p. 11).

Boone (1988) identified ten essential elements that should be included in the problem-solving approach to teaching. The ten essential elements identified by Boone (1988) were:

1. Instruction is organized around solvable problem statements.
2. Students explore the problem situation.
3. Students develop a clear-cut statement of the problem.

4. Students discover possible solutions to the problem.

5. Students find and interpret information needed to analyze the possible problem solutions.

6. Students discover factors to be considered in accepting the problem solution.

7. Students weigh and process information gathered to determine its significance to the problem statement.

8. Students discuss and arrive at a tentative solution to the problem.

9. Students implement the solution under the teachers' guidance.

10. Students evaluate the results of the problem solution. (p. 47)

For the purpose of the study, the extent that agriculture student teachers and cooperating teachers used the problem-solving approach to teaching was operationally defined by the scores attained on the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory (Appendix B). Boone's (1988) 10 essential elements of the problem-solving approach to teaching and a review of
the literature on the problem-solving approach to teaching were utilized in developing the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory.

Teaching Methods

Teaching methods are important tools for teachers and students to use during the problem-solving approach to teaching (Phipps & Osborne, 1988; Crunkilton & Krebs, 1982). The purpose of teaching methods is to provide students with the factual information needed to solve the problem before the class (Newcomb, McCracken, & Warmbrod, 1986). Furthermore, while teaching using the problem-solving approach, teaching methods are very helpful in developing "tentative solutions and final conclusions to problems" (Newcomb, McCracken, & Warmbrod, 1986, p. 103).

For the purpose of the study, the teaching methods utilized by student teachers and cooperating teachers were operationally defined by the scores attained on the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory (Appendix B). The teaching methods identified were recognized as teaching methods utilized in the teaching of agriculture and in teaching using the problem-solving approach to teaching (Newcomb, McCracken, & Warmbrod, 1986; Crunkilton & Krebs, 1982; Phipps & Osborne, 1988).
Limitations of the Study

The study was descriptive and relational in nature. A relational study cannot establish cause-and-effect relationships among variables (Borg & Gall, 1989). Therefore, the study sought only to describe characteristics and test hypothesized relationships among characteristics.

The study was further limited by the method of subject selection. Accessible samples of agriculture student teachers and cooperating teachers were selected to participate in the study. The agriculture student teachers and cooperating teachers were restricted to those who were engaged in the student teacher practicum at The Ohio State University during Autumn Quarter, 1992. Therefore, results of the study were generalizable only to the accessible student teacher and cooperating teacher samples.

Assumptions

The researcher assumed that cooperating teachers selected to supervise student teachers during the Autumn Quarter, 1992 had previously been prepared in their preservice or inservice teacher preparation program to teach using the problem-solving approach to teaching. Without such an assumption, measurement of the extent of use of the problem-solving approach to teaching by the cooperating teachers would not be appropriate.

Significance of the Problem

Buriak and Shinn (1991) conducted a study for the purpose of arriving at a consensus document providing structure for
research in agricultural education. Buriak and Shinn's (1991) research agenda for agricultural education was structured into research problem areas, research activities, and research objectives.

One of the four research problem areas identified was a "knowledge base for learning and teaching" which included a research activity in "critical thinking and problem-solving" (Buriak & Shinn, 1991). In addition, the research problem area of "delivery methodologies" was identified and included a research objective entitled "learning style - teaching style interactions" (Buriak & Shinn, 1991). One can therefore conclude that research in the area of learning styles and problem-solving is in agreement with the research mission of the agricultural education profession.

Furthermore, Crunkilton (1988), in an address to the American Association of Teacher Educators in Agriculture, asked if the agricultural education profession really knew all there was to know about the teaching-learning process. Crunkilton (1988) added that "we need to encourage research in those areas that have been neglected and perhaps areas that are more important today, research areas that will help our teachers to be better at what they do and help us [teacher educators] do our job better at preparing those teachers to do what they are supposed to do" (p. 3).

The agricultural education profession has clearly advocated the use of the problem-solving approach to teaching.
It is the philosophy of the agricultural education profession that the problem-solving approach is the instructional approach that is most effective for teaching students of agriculture (AAAE, 1991). Preservice teachers of agriculture at The Ohio State University spend a considerable amount of time in preparing to teach using the problem-solving approach to teaching. Yet, teacher educators in agriculture at The Ohio State University express concern with regards to the use of the problem-solving approach to teaching during the student teaching practicum and ultimately during the teacher's professional career.

Knowledge regarding the learning styles that teachers of agriculture possess will place teacher educators in a more desirable position to educate and prepare teachers of agriculture. Furthermore, research with regard to the relationship between an individual's learning style and the extent he/she uses the problem-solving approach to teaching will assist teacher educators in the preparation of future teachers of agriculture.
CHAPTER II
REVIEW OF LITERATURE

Purpose of the Study

The purpose of the study was to test the hypothesized relationships between student teachers' preferred learning styles and problem-solving ability and the extent of use of the problem-solving approach to teaching during the student teaching practicum. The study further sought to test the hypothesized relationship between the extent cooperating teachers utilized the problem-solving approach to teaching and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. In addition, the study sought to describe the teaching methods utilized, by student and cooperating teachers, while using and not using the problem-solving approach to teaching during the student teaching practicum.

To acquire knowledge concerning the problem-solving approach to teaching and learning styles, a review of literature was conducted. The literature review focused upon the problem-solving approach to teaching and the field-dependence/independence learning style dimension.
Problem-Solving Approach To Teaching

The problem-solving approach to teaching has a long history in agricultural education (Long, 1983; Lass & Moss, 1987; Herren, 1987). Educators in the agricultural education profession have promoted the problem-solving approach as the most effective approach for teaching agriculture (Martin, 1982; Newcomb, 1982). Given the historical and philosophical significance of the problem-solving approach to teaching in agricultural education, it was important to examine the approach as the way to teach agriculture. Therefore, the philosophy underlying the problem-solving approach to teaching, the approach's historical development, and the procedures of the approach were examined. Furthermore, research conducted in the agricultural education profession regarding the problem-solving approach to teaching was reviewed.

Philosophical Considerations

One of the responsibilities of teacher education programs in agriculture is the preparation of teachers to advance agricultural education in public schools. Birkenholz (1986) stated that to fulfill the responsibility of preparing teachers of agriculture, teacher educators must provide teachers with the skills and knowledge necessary for conducting quality agriculture programs.

Birkenholz (1986) suggested that the requisite skills needed by teachers of agriculture included teaching
methodology, knowledge of agricultural subject matter, and an understanding of the principles upon which an agricultural education program was based. A philosophical principle and teaching approach promoted by the agricultural education profession is the problem-solving approach to teaching (AAAE, 1991).

The committee for the Preparation of Professionals for Agricultural Education (AAAE, 1991) identified decision making through problem-solving as one of the basic principles of the agricultural education profession. In addition, teacher educators from other academic areas support teaching teachers how to teach using an inquiry-oriented (problem-solving) approach to teaching (ATE, 1991).


1. Students do not need to learn basic skills before they learn problem-solving skills. The two go together. They are not sequential but mutually reinforcing;
2. Learning should be reoriented away from mere mastery of information and toward encouraging students to recognize and solve problems; and,

3. Real know how - foundation and competencies - cannot be taught in isolation; students need practice in the application of these skills. (p. 19)

Hunter (1971) has long supported teaching students subject content through a problem-solving approach. Hunter (1971) concluded that:

It is not sufficient for a learner to merely understand the meaning of concepts and generalizations. They must be able to apply this learning outside of the classroom setting. You, as their teacher, should develop strategies so the students acquire and use knowledge to implement the problem-solving and creative process rather than acquiring knowledge as an end product. (p. 92)

Problem-solving is an approach to learning and teaching that implies involvement in discovering solutions to problems directly relevant to the needs of the learners (Stewart, 1950). Problem-solving focuses upon decision-making skills rather than on rote learning (Long, 1983). To be engaged in problem-solving, a learner must think critically and make choices among alternate courses of action (AAAE, 1991).
Newcomb (1982) stated that "problem solving teaching is a way of thinking. It is a process by which one is able to learn" (p. 9). The "ultimate goal in problem teaching is to make students able to solve new problems without help. If this goal can be accomplished, then teachers have truly educated them" (Lancelot, 1929, p. 134). Whenever students have reached the point where they can think through and solve a problem, then they have achieved the most important objective of agricultural education and all of education (Dickerson, 1984).

However, can a teacher teach utilizing the problem-solving approach while not believing in the approach as a way to teach and learn? Krebs (1982) stated that the teaching approach utilized by a teacher was a reflection of what that teacher believed were the purposes of education. Krebs (1982) added that "the shaping of a faith in or a lack of faith in problem solving can be found in one's philosophy of education" (p. 5). Therefore, one must determine if the purpose of education is to teach knowledge and facts or to teach students how to think and solve problems so that they can lead a successful life.

Crunkilton (1984) stressed that a teacher must remember that teaching agriculture for the sake of knowledge and facts does not fully accomplish the purpose of agricultural education. Students of agriculture must be challenged to develop their thinking ability because "...the development of
the ability to solve problems is probably the most important aspect of one's education" (Troutman & Lichtenberg, 1974, p. 590).

Problem-solving as a way of teaching is not a new concept in education or agricultural education. The agricultural education profession has been promoting the problem-solving approach to teaching for decades (Herren, 1987). Newcomb (1982) suggested that the problem-solving approach to teaching was as sacred in agricultural education as the FFA. Crunkilton (1988) concluded that "problem solving, both as a method of teaching and as a skill that students need, is more critical today than it was years ago" (p. 8). But, who were the individuals responsible for the inception and subsequent development of the problem-solving approach to teaching in agricultural education?

Historical Development

The development of the problem-solving approach to teaching utilized in agricultural education has not been the work of one individual, but a synthesis of ideas and beliefs of several individuals (Lass & Moss, 1987). Several educators have identified and outlined procedures for using the problem-solving approach in the teaching of agriculture (Figure 1). An early promoter of teaching through problem-solving was John Dewey.
Figure 1. Authors of Textbooks Promoting the Problem-Solving Approach To Teaching in Agricultural Education

Dewey (1910) concluded, that teaching students how to think was extremely important in educating them for membership in society. Dewey (1910) emphasized student centered education that enabled students to learn from their own experiences by working through their own problems. Rather than using the term "problem-solving," Dewey outlined the steps to teaching as "Reflective Thinking" which coincided with the steps of modern day problem-solving (Newcomb, McCracken, & Warmbrod, 1986). Dewey (1910) outlined five steps to the "Reflective Thinking" process. Dewey's (1910) five steps in "Reflective Thinking" were:

1. Felt difficulty;
2. Its location and definition;
3. Suggestion of possible solutions;
4. Development by reasoning of the bearing of the suggestion; and
5. Further observation and experiment leading to its acceptance or rejection.

(p. 72)

Charters (1912)

A follower and student of Dewey was Warrent Wallace Charters (Lass & Moss, 1987). Charters stated, "I suppose I should be classed as a disciple of Dewey because I studied under him during his last three years" (Stewart, 1933, p. 115). Charters believed that the normal learning process involved problems and that students could be successful in the learning process when they attempted to find solutions to their own problems.

Charters contended that teachers should search the experiences of students to find relevant problems of value. Furthermore, Charters professed that the best way to teach new subject matter was through the defining of a problem and in the development of solutions to the problem (Lass & Moss, 1987; Herren, 1987).

Charters emphasized that problems used in teaching should be real problems and should be of importance to the students. Furthermore, the problems should serve as a motive or interest for learning the subject content (Lass & Moss, 1987). Charters (1912) identified three steps to use when teaching utilizing problem-solving. Charter's three steps were:

1. Recognition of the problem or defining the problem.
2. Attempt at solutions or forming hypotheses.

3. Testing the solutions or verification of proposed solutions.

**Lancelot (1944)**

An early promoter of teaching agriculture through a problem-solving approach was William Henry Lancelot, a vocational teacher educator at Iowa State College, in Ames (Kahler, 1977). Lancelot was never a classroom student of Dewey; however, Lancelot may have been influenced by the work and philosophical views of Dewey (Lass & Moss, 1987).

Lancelot (1929, 1944) advocated using problem-solving in teaching as a way for permanent learning to occur. Lancelot believed that in order for a person to learn he/she must first be required to think. Therefore, a "teacher's rule should be to explain nothing that [students] are able to think through for themselves" (Lancelot, 1944, p. 67). Lancelot's philosophy on students being required to think in order to learn was in concordance with the writings and philosophy of Dewey.

Lancelot (1944) stated that "a first law of all good teaching is that pupils must be kept thinking. For where there is no thinking, there is no learning, and where there is no learning, there is no teaching" (p. 143). In order to be kept thinking, Lancelot proposed that students be engaged in solving problems.
For teachers to solve problem with students, Lancelot (1944) identified and defined five steps to use in classroom problem-solving. The five steps in problem-solving teaching identified by Lancelot (1944) were:

1. Clearly state the problem.
2. Arrive at an early inference as to the probable answer.
3. Gather additional facts which seem to have a bearing upon the problem.
4. Revise or restate the original inference in such a manner as to bring it into closest possible agreement with all of the facts in hand.
5. Test this revised inference, or conclusion, to determine how great a confidence may be placed in it: its validity. (pp. 90-92)

In addition, Lancelot (1944) defined five thinking abilities that high school teachers should develop in students when teaching using problem-solving. The five thinking abilities identified by Lancelot (1944) were: general thinking ability, exact reasoning ability, judgement ability, creative ability, and manual ability.

Stewart (1950)

Lancelot had many followers of his writings and teachings on the problem-solving approach to teaching. One of
Lancelot's followers was W. F. Stewart, a teacher educator at The Ohio State University (Kahler, 1977). Stewart believed that if teaching was to be interesting, useful, and challenging for students, then the students had to be engaged in thinking and solving relevant problems (Bender & Wolf, 1972). Stewart (1950) stated that "the child learns to think only by thinking; he [sic] learns to solve problems only by practice in solving problems. To improve thinking and problem-solving in general, abundant practice must be provided in all school subjects and activities" (pp. 124-125).

Stewart (1950) identified five steps for teachers to use with students in the solving of problems. Stewart's (1950) five steps to solving problems were:

1. State the problem as clearly and definitely as its life situation permits.
2. Recall or find out the factors having a bearing upon the problem.
3. Recall or find out the facts related to each factor.
4. Evaluate the factors by recognizing their relative importance in the specific situation under consideration.
5. With consideration given to the evaluation, make the decision. (p. 133)

In addition, Stewart (1950) identified four "patterns" to use in problem-solving. The four "patterns" were: the forked-
road situation; the possibilities-factors chart; given a situation to be improved; and given an effect, to find the cause or causes. Stewart, in *Methods of Good Teaching* (1950), explained how the four "patterns" of problem-solving related to the thinking abilities that teachers should instill in students. For example, in solving a forked-road situation, students were required to use the judgement thinking ability as described by Lancelot (1944).

Stewart (1959) stated that not all teaching in agriculture could be based on problem-solving. Stewart (1959) estimated that sixty percent of the lessons taught by agriculture teachers could deal with managerial abilities and therefore involve problem-solving. It was recommended that when teachers found it impossible to teach on the basis of problem-solving, that they place an emphasis on reasoning, understanding and judgement as mental abilities worthy of development through abundant practice in answering carefully planned questions (Stewart, 1959).

*Hammonds (1950)*

An additional follower of Lancelot was Carsie Hammonds, a teacher educator at the University of Kentucky (Kahler, 1977). Hammonds (1950) stated that "thinking on the part of the students is usually present in good teaching" (p. 96) and in problem-solving, students engage in thinking. Hammonds (1950) further stated that "the central and essential characteristics of problem-solving in teaching is the solving
of problems" (p. 97) on the part of the students. Hammonds (1950) identified six steps or phases in problem-solving and drew a parallel between his six steps/phases and Dewey's "Reflective Thinking." The six steps/phases to problem-solving identified by Hammonds (1950) were:

1. Discover the difficulty in a situation.
2. State the problem.
3. Analyze the problem.
4. Students find the information to solve the problem.
5. Pool the finding and decisions and arrive at a solution.
6. Do whatever remains to remove the difficulty. (p. 97)

Rhoad (1951)

C. E. Rhoad (1951), a teacher educator at the University of Nebraska and former teacher educator at The Ohio State University, stated that problem-solving required reflective thinking and included reasoning, judgment, and creative thought. Rhoad (1951) identified twenty steps for the teacher to follow in teaching utilizing a problem-solving "method." The steps identified by Rhoad (1951) in using problem-solving as a teaching "method" were:

1. Determine the educational objectives to be attained.
2. Help students set up adequate farming programs.

3. Discover and select problems (the solving of these problems should produce the desired changes in learners).

4. Solve the problem yourself (teachers should plan, secure facts, and work out the problem).

5. Motivate the problem (arouse in the class a desire to solve the problem).

6. Draw from the class a clear cut statement of the problem (the problem must be clearly and fully defined for reflective thinking to occur).

7. Help students discover the possible solutions to the problem.

8. Help the class discover the factors to be considered.

9. Help students find and interpret the needed information.

10. Help students weigh the information.

11. Call for a written decision by each student.

12. Arrive at a class conclusion.

13. Help students clearly state the reasons for the class conclusion.
14. Make sure that important information is recorded in students' notebooks.

15. Have class help other students solve their problems if necessary.

16. Make sure that the student (and usually the teacher) confers with the father [sic] as to the carrying out of the solution to the problem.

17. Help students write their farming program plans.

18. Help the student carry out his [sic] plan.

19. Help students keep and analyze records for use in teaching.

20. Evaluate your teaching on the basis of that proportion of the plan that was successfully put into action. (pp. 6-52)

In addition, Rhoad (1951) identified four "variations" of problem-solving to use with students in solving problems. The four problem-solving "variations" were: possibilities-factors table; process or procedures; comparing present situation with accepted standards, and evaluating facts in a YES or NO decision. An analysis of Rhoad's four "variations" of problem-solving reveals a similarity to the four "patterns" of problem-solving previously identified by Stewart (1950). The
similarity may be attributed to Rhoad and Stewart being on the faculty at The Ohio State University at the same time.


Phipps, a teacher educator at the University of Illinois, advocated teaching using problem-solving based on the philosophy of Dewey. Phipps (1952) stated that the "problem solving procedure is recognized as being an effective means of developing and securing desirable learning. It stimulates interest, develops thinking ability, and helps students to evaluate, draw inferences, and make decisions essential to the solution of a problem" (p. 121).

Phipps (1952) identified six steps to teaching in the classroom using problem-solving and described the problem-solving process as the gathering of facts, data, and information necessary in solving a problem. The six steps to teaching using problem-solving as identified by Phipps (1952) were:

1. A problem situation which is recognized through teacher-student planning of objectives and consideration of ways and means of meeting these objectives.

2. Definition of a problem through teacher-student analysis of the problem situation.
3. An attempt by the class to solve the problem by pooling their experiences and ideas.

4. Validating or disproving the hypotheses suggested by the class. With high school pupils this job is done during supervised study periods.

5. A class discussion for the purpose of reporting the results of attempts to validate hypotheses. At this point, it may be necessary to revise hypotheses or state new hypotheses which must be validated.

6. The class arrives at a conclusion to the problem which they are willing to accept and which is based on all available facts. (p. 135)

Phipps (1952) concluded that "if departments of vocational agriculture cannot give their students the ability to solve the problems they meet, they are not providing agricultural education" (p. 125). Phipps further classified the problem-solving approach by the type of thinking required in the solution of the problem.

Problems could be classified as either creative problems, inductive problems, judgement problems, or reasoning problems (Phipps, 1952). Although not mentioned by name, one may be
led to believe that Lancelot had an impact upon the teaching philosophy of Phipps because of how Phipps relates problem-solving to thinking in a similar fashion. Phipps authored four additional editions to a textbook on the subject of agricultural education in the public schools and all four editions (1965, 1966, 1972, 1980) included the same section on problem-solving identical to the 1952 edition.


Krebs, a teacher educator at the University of Illinois and later at the Virginia Polytechnic Institute and State University, and Crunkilton, a teacher educator at the Virginia Polytechnic Institute and State University, advocated teaching agriculture using the problem-solving approach to teaching. In the three editions (Krebs, 1954, 1967; Crunkilton & Krebs, 1982) the authors identified a five-step teaching procedure for teaching agriculture subjects using the problem-solving approach to teaching. No differences were found between the three editions (Krebs 1954, 1967; Crunkilton & Krebs, 1982) on describing the problems-solving approach to teaching. Therefore, focus will be given to Krebs' (1954) first edition. The five steps to teaching using the problem-solving approach identified by Krebs (1954) were:

1. Interest approach;
2. Anticipated group objectives;
3. Anticipated problems and concerns of the pupils;
4. Steps in solving the problems;
5. Evaluation and application. (pp. 22-28)

Krebs' (1954) procedures for teaching using problem-solving were described differently than the problem-solving approach procedures of the previous authors. Krebs was the first to base the use of the problem-solving approach to teaching on the need of the teacher to organize his/her teaching plan. Crunkilton and Krebs (1982) stated that "it provides the teacher with a plan for organizing teaching which includes the maximum freedom for using the teacher's own creative talents to teach in a manner that will be most successful and satisfying both to the teacher and to the student" (p. 3).

**Drawbaugh and Hull (1971)**

Drawbaugh, a teacher educator at Rutgers State University, and Hull, a teacher educator at Oklahoma State University, advocated that agriculture teachers should be using a problem-solving approach to teaching. Drawbaugh and Hull (1971) related the problem-solving approach to teaching to Dewey's "Reflective Thinking." Drawbaugh and Hull (1971) described "five problem-solving steps" that could be used in teaching students subject content by solving relevant real-life problems. The "five problem-solving steps" identified by Drawbaugh and Hull were:
1. Recognition of a problem - if thinking is to occur, two or more possible solutions must be presented.

2. Statement of the problem.

3. Construction of guiding hypotheses - collecting of factual data by pursuing one solution at a time.

4. Reasoning - which solution is the best result.

5. Testing the solution by action. (pp. 50-51)

Binkley and Tulloch (1981)

Binkley and Tulloch (1981), teacher educators at the University of Kentucky, stated that "... good teachers of agriculture do their teaching partly or wholly on a problem basis" (p. 79). Binkley and Tulloch (1981) further concluded that "...to think well in any given field or subject (agriculture, for example) is one of the desired results of instruction in it. Success in a field usually depends on the ability of the person to think effectively in that field" (p. 83) and by using the problem-solving approach to teaching, students are engaged in an active learning process that requires thinking.

Binkley and Tulloch (1981) directly related Dewey's "Reflective Thinking" process to the problem-solving approach to teaching. In Teaching Vocational Agriculture/Agribusiness...
Binkley and Tulloch (1981) listed and compared the similarities between the six steps of the problem-solving approach to teaching and the steps to Dewey's "Reflective Thinking." The six steps of the problem-solving approach to teaching as identified by Binkley and Tulloch (1981) were:

1. The students discover the difficulty in a situation.
2. The students state the problem which, when solved, will remove the difficulty.
3. The teacher analyzes the problem - gets out the factors to consider - with the group members so that they may see how to solve it.
4. Each student finds the information needed that is not already possessed and solves the problem.
5. Through a discussion, under teacher guidance, the students pool the findings and decisions and arrive at a final conclusion.
6. The students do whatever remains to be done to remove the difficulty. (p. 80)

In addition, Binkley and Tulloch (1981) stated that the "central and essential characteristic of problem-solving in teaching is the solving of problems," (p. 80) problems that students face as a group or as individuals.
Newcomb, McCracken, and Warmbrod (1986)

Newcomb, McCracken, and Warmbrod (1986), teacher educators at The Ohio State University, based the problem-solving approach to teaching on Dewey's "Reflective Thinking" process and the principles of teaching and learning. In addition, Newcomb, McCracken and Warmbrod (1986) referred to "Reflective Thinking" as "The Chain of Reasoning," "The Method of Science," "The Learning Process," and "The Scientific Method" (p. 65). Newcomb, McCracken, and Warmbrod (1986) identified six steps to the problem-solving approach to teaching and compared the six steps directly with "The Learning Process." The six steps to the problem-solving approach to teaching identified by Newcomb, McCracken, and Warmbrod (1986) were:

1. Interest approach;
2. Group objectives;
3. Questions to be answered;
4. Problem solution;
5. Testing solutions through application;
6. Evaluation of solutions. (p. 67)

An analysis of Newcomb, McCracken, and Warmbrod's (1986) steps to the problem-solving approach to teaching revealed a similarity to the six steps identified by Krebs (1954, 1967) and Crunkilton and Krebs (1982). One may conclude that the similarities between the two approaches to the problem-solving approach to teaching can be attributed to the fact that
Warmbrod was Krebs' colleague at the University of Illinois and that Newcomb studied under Krebs at Virginia Polytechnic Institute and State University. Consequently, Krebs had an influence on the problem-solving approach to teaching philosophy of both Warmbrod and Newcomb.

Phipps and Osborne (1988)

In the fifth edition of the *Handbook On Agricultural Education In Public Schools* (1988) Osborne, teacher educator at the University of Illinois, was added as a second author. Phipps and Osborne (1988) identified seven steps to the problem-solving approach to teaching. The seven steps were:

1. Recognition of a problem situation, leading to teacher-student planning of objectives.

2. Definition of a problem through teacher-student analysis of the problem situation.

3. An attempt by the class to solve the problem by pooling experiences and ideas.

4. Validation or disproving of the hypotheses suggested by the class by gathering data and sharing experiences.

5. Class discussion to report results of attempts to validate hypotheses. Revision of hypotheses may be necessary.
6. Class arrives at a conclusion to the problem.

7. Application of the conclusion(s) to the problem situation and evaluation of the results. (p. 158)

In the five previous editions, Phipps (1952, 1965, 1966, 1972, 1980) recognized six steps to the problem-solving approach to teaching. In the Phipps and Osborne (1988) edition, a seventh step was added. The seventh step was the "application of the conclusion(s) to the problem situation and evaluation of the results" (p. 158).

Hedges (1991)

Hedges (1991), a teacher educator at The Ohio State University, is the last of a long list of teacher educators in agricultural education promoting the problem-solving approach to teaching. Hedges was influenced by the work of W. F. Stewart for there were similarities between the work of Hedges (1991) and Stewart (1950). Hedges (1991) made reference to the impact that Stewart and others at The Ohio State University had upon his teaching career.

Hedges (1991) identified the problem-solving approach to teaching as a combination of critical thinking, problem-solving, and decision making, and promoted six problem-solving "techniques" to be used in planning and teaching. Hedges (1991) maintained that teachers could utilize the six problem-solving "techniques" because people used them in everyday life.
to solve problems. The six problem-solving "techniques" identified by Hedges (1991) were:

1. Forked-Road Situation: students have two choices as a solution to the problem.

2. Possibilities - Factors: students have more than two options as solutions to a problem.

3. Key Steps: specific steps or operations are required, usually in sequence, for development, construction, maintenance, adjustment, and/or repair.

4. Situation-To-Be-Improved: students need to make recommendations for improving the situation by comparing the present situation to the ideal situation.

5. Given the Effect, Find the Cause: students need to determine the cause of the problem and options for action.

6. Four Questions:
   a. How important is ________________?
   b. What problems have we had with ____?
   c. What do we need to know or be able to do in order to correct or prevent these problems?
   d. What is the related information needed?

(pp. 8-9)
Hedges (1991) noted that problems to be solved or decisions to be made could serve as the basis of a teacher's teaching. The types of problems to be solved could be classified by the type of thinking involved in the resolution of the problem (Hedges, 1991). Therefore, Hedges (1991) classified the six problem-solving "techniques" by the type of thinking required to solve the problem. The type of thinking required to solve the six problem-solving "techniques" were (Hedges, 1991, p. 3):

<table>
<thead>
<tr>
<th>Type of Thinking</th>
<th>Problem-Solving &quot;Technique&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Creative</td>
<td>Four Question</td>
</tr>
<tr>
<td>2. Inductive</td>
<td>Effect/Cause</td>
</tr>
<tr>
<td></td>
<td>Situation-To-Be-Improved</td>
</tr>
<tr>
<td>3. Reasoning</td>
<td>Key Steps</td>
</tr>
<tr>
<td>4. Judgement</td>
<td>Forked-Road</td>
</tr>
<tr>
<td></td>
<td>Possibilities-Factors</td>
</tr>
</tbody>
</table>

Summary of the Historical Development

The problem-solving approach to teaching has had a long history in the teaching of agriculture. The problem-solving approach to teaching has been promoted as a way to teach since the early 1900s and some have considered the problem-solving approach the "hallmark" of teaching in agricultural education. It can be concluded that the problem-solving approach to teaching was not the work of one individual. However, several of the problem-solving approaches to teaching advocated today can be traced to the educational philosophy of John Dewey.
From the references cited, one can conclude that there are two common essential characteristics of the problem-solving approach to teaching. First and foremost, problems to be solved should be real problems of students or potential problems that students may face later in their chosen careers. Secondly, in problem-solving, students should be required to think critically and make choices between alternative solutions to the problems, "for where there is no thinking, there is no learning, and where there in no learning, there is no teaching" (Lancelot, 1944, p. 143).

Finally, teaching utilizing a problem-solving approach is a way for students and the teacher to create interest-in and organize the subject content to be learned. Problem-solving is a way to maintain students' interest in the subject matter throughout the lesson by solving relevant real-life problems. However, one must ask how effective is the problem-solving approach to teaching and to what extent do teachers of agriculture use the problem-solving approach in their teaching?

Research on the Problem-Solving Approach To Teaching

It is only through the collection of empirical data that educators and researchers are able to test theories based on theoretical and philosophical considerations (Flowers, 1988). The problem-solving approach to teaching has been promoted for years by the agricultural education profession as the way to teach; however, few empirical studies (Schneider, 1978;
Chiappetta & Russell, 1982; Curbelo, 1985; Warmbrod & Chuatong, 1987; Flowers, 1988; Flowers & Osborne, 1988; Boone & Newcomb, 1990) existed with regard to the effectiveness of the problem-solving approach to teaching on student achievement and retention. Furthermore, few studies (Chuatong, 1986; Boone, 1988; Osborne & Hamzah, 1989; McKee & Warmbrod, 1992a; McKee & Warmbrod, 1992b) have been conducted regarding the extent that teachers of agriculture actually utilized the problem-solving approach to teaching.


The following is a summary of research conducted in agricultural education with regards to the effectiveness, as measured by student achievement and retention, of the problem-solving approach to teaching. In addition, literature
focusing on the extent that the problem-solving approach to teaching has been utilized by teachers of agriculture will be explored.

**Student Achievement and Retention**

Flowers (1988) conducted a review of literature that identified studies relating to the problem-solving approach to teaching. Flowers (1988) focused his literature review on the effects of the problem-solving approach to teaching on student achievement. Although Flowers (1988) found conflicting findings among the studies reviewed, the evidence did seem to indicate a superiority of problem-solving teaching in relation to other instructional approaches with regard to student achievement.

One study (Curbelo, 1985) of particular interest reviewed by Flowers (1988) was the meta-analysis of experimental studies involving problem-solving as one of the treatments. Curbelo (1985) included 68 experimental studies of problem-solving in the meta-analysis. Curbelo (1985) concluded that students taught through a problem-solving approach realized greater achievement scores than students taught with other approaches to teaching. In addition, Flowers (1988) reported that other studies (Chiappetta & Russell, 1982; Schneider, 1978) had supported teaching through a problem-solving approach.

Flowers and Osborne (1988) studied the effects of the problem-solving approach to teaching on student achievement
and retention. The results indicated no significant differences on student achievement between students taught with the problem-solving approach and students taught with the subject matter approach (Flowers & Osborne, 1988). However, results of the retention test (one week following the achievement test) indicated that students taught with the problem-solving approach had slightly lower achievement loses than students taught with the subject matter approach (Flowers & Osborne, 1988). Flowers and Osborne (1988) concluded that the problem-solving approach was no more or less effective than the subject matter approach as measured by student achievement and retention.

Chuatong (1986) studied vocational horticulture students' ability to solve problems in the area of technical horticulture. In addition, relationships were investigated between the students' problem-solving ability and academic aptitude, extent to which teachers used problem-solving teaching behaviors, degree of involvement in supervised occupational experience programs, participation in the FFA, and the emphasis of the program in which students were enrolled (greenhouse/floriculture, landscape, or combination) (Chuatong, 1986).

Chuatong (1986) concluded that most of the vocational horticulture students in the study demonstrated less than an average level of academic aptitude and did not demonstrate a very high level of problem-solving ability. It was found that
the higher the students' academic aptitude and general knowledge in horticulture, the better the students were at solving technical horticultural problems (Chuatong, 1986).

Vocational horticulture students who were more involved in supervised occupational experience programs were more likely to acquire knowledge in general horticulture and were found to perform better when solving technical horticultural problems (Chuatong, 1986). In addition, Chuatong (1986) found that students' level of participation in the FFA tended to influence their knowledge level in general horticulture. Students with higher levels of participation in the FFA were found to score higher in general horticultural knowledge. However, Chuatong (1986) concluded that students' level of participation in the FFA was not likely to vary with their problem-solving ability.

Results with regard to the extent teachers utilized problem-solving teaching behaviors were mixed. Chuatong (1986) concluded that the more extensively teachers perceived they used problem-solving teaching behaviors, the higher students scored on general horticulture achievement. However, the extent to which teachers perceived they employed problem-solving teaching behaviors was not related to the students problem-solving ability (Chuatong, 1986).

Chuatong's (1986) conclusions were that vocational horticulture students did not demonstrate very high levels of problem-solving ability. Chuatong (1986) further concluded
that academic aptitude, involvement in supervised occupational experience programs, and subject matter emphasis of the horticulture program influenced a student's problem-solving ability. In addition, it was concluded that a teacher's use of problem-solving teaching behaviors could influence students' achievement in horticulture (Chuatong, 1986).

Boone and Newcomb (1990) compared the effects of the problem-solving approach to teaching with a subject matter approach to teaching on student achievement and retention. Little difference was found between the two approaches used by the teachers participating in the study (Boone & Newcomb, 1990). Boone and Newcomb (1990) concluded that a positive relationship existed between the degree to which a teacher utilized the problem-solving approach to teaching and the level of student achievement. However, no differences were found between the two approaches to teaching with regard to student retention (Boone & Newcomb, 1990). With the mixed findings regarding students' achievement and retention, the question could be asked: to what extent did teachers of agriculture teach utilizing the problem-solving approach to teaching?

Extent of Use of the Problem-Solving Approach

Despite the support for teaching utilizing the problem-solving approach, studies (Boone, 1988; Osborne & Hamzah, 1989) have found that teachers of agriculture organized their lessons on a problem-solving basis, but did not follow through
with actual problem-solving teaching in the classroom. Boone and Newcomb (1990) concluded that the teachers participating in their study could not distinguish between teaching with the problem-solving approach or subject matter approach to teaching. Furthermore, teachers who were utilizing the problem-solving approach to teaching were not fully employing all of the essential elements of the problem-solving approach to teaching (Boone & Newcomb, 1990).

Chuatong (1986) used two comparable versions of a rating instrument, one for students and one for teachers, to measure the extent to which teachers used problem-solving teaching behaviors. Chuatong (1986) reported that students perceived their teachers to be engaged in problem-solving learning experiences approximately half of the time in class. However, on the average, teachers rated themselves higher than the students. Teachers self-reported that they employed problem-solving teaching behaviors slightly more than half of the time in the classroom (Chuatong, 1986). A low positive relationship between students' ratings and the teachers' self-ratings of the extent to which problem-solving was occurring in the classroom was reported (Chuatong, 1986).

Osborne and Hamzah (1989) examined the use of the problem-solving approach to teaching by teachers in Illinois. Teachers self-reported using the problem-solving approach "very much" to "exclusively" during student teaching (Osborne & Hamzah, 1989). Furthermore, teachers self-reported that
they were presently using the problem-solving approach with high levels of confidence (Osborne & Hamzah, 1989). However, teachers also reported a high use of the lecture-discussion method of teaching (Osborne & Hamzah, 1989).

With regard to relationships, Osborne and Hamzah (1989) reported moderate relationships between teachers' current use of the problem-solving approach and (1) use of problem-solving during student teaching; (2) emphasis placed on problem-solving by the cooperating teacher and university teacher educator during student teaching; and (3) current level of confidence in using the problem-solving approach to teaching.

Sixty percent of the variance in the teachers' use of problem-solving was explained by four variables. The four variables were: (1) teachers' attitude toward the problem-solving approach to teaching (48%); (2) teachers' confidence in ability to use the problem-solving approach when beginning their teaching career (6%); (3) percentage of students with supervised occupational experience programs (4%); and (4) use of the problem-solving approach during student teaching (2%) (Osborne & Hamzah, 1989).

Osborne and Hamzah (1989) concluded that teachers used problem-solving more in their teaching if it was used during student teaching and was encouraged throughout the teacher preparation program. Furthermore, it was concluded that teacher educators and cooperating teachers must provide consistent support and encouragement to preservice teachers in
their efforts to use the problem-solving approach to teaching (Osborne & Hamzah, 1989).

McKee and Warmbrod (1992a) studied the extent that first year teachers of agriculture used the problem-solving approach to teaching. The first-year teachers in the study had completed a preservice teacher education program that emphasized problem-solving teaching. The results indicated that the first-year teachers perceived they were utilizing the problem-solving approach to teaching (McKee & Warmbrod, 1992a). Furthermore, an analysis of the teachers' classroom teaching confirmed that the teachers were in fact utilizing the problem-solving approach considerably, but not exclusively (McKee & Warmbrod, 1992a). When the teachers were not using the problem-solving approach, the lecture/subject matter approach was found to be the alternate choice (McKee & Warmbrod, 1992a).

McKee and Warmbrod (1992a) further reported that the extent to which teachers demonstrated problem-solving teaching in their first year of teaching was positively and substantially related to the extent that the teachers demonstrated the problem-solving approach in their preservice teaching course. However, no relationship was found between the extent that the teachers demonstrated the problem-solving approach and their general problem-solving ability as measured by the Cornell Critical Thinking Test (McKee & Warmbrod, 1992a).
A similar study (McKee & Warmbrod, 1992b) revealed that student teachers were not fully utilizing the problem-solving approach to teaching. Furthermore, agreement was not reached among student teachers, cooperating teachers, and university teacher educators with regard to their perceptions of the extent to which student teachers used the problem-solving approach during student teaching (McKee & Warmbrod, 1992b).

Likewise, agreement was not evident between cooperating teachers and student teachers in their perceptions of the extent to which cooperating teachers modeled the problem-solving approach during student teaching (McKee & Warmbrod, 1992b). Furthermore, student teachers reported that the cooperating teachers provided little instruction or supervision in further developing their skills in teaching using the problem-solving approach.

Student teachers reported that the problem-solving approach to teaching was difficult to use (McKee & Warmbrod, 1992b). Difficulties, as described by student teachers, with using the problem-solving approach to teaching included: (1) extensive time required to plan; (2) subject not suited to teaching through the problem-solving approach; (3) lack of real problems by students; (4) inadequate supervised occupational experience projects; and (5) lack of technical agriculture knowledge on the part of students and/or student teachers (McKee & Warmbrod, 1992b).
One year later, the same teachers, now in their first year of teaching, reported the same difficulties with using the problem-solving approach to teaching (McKee & Warmbrod, 1992b). McKee and Warmbrod (1992b) concluded that more careful attention with regard to the problem-solving approach to teaching needed to be given to preservice teachers' methods courses and the student teaching practicum experience.

Summary of Research on the Problem-Solving Approach To Teaching

Although there appears to be a lack of research with regard to the problem-solving approach to teaching, Flowers (1988) concluded that the existing research did support using the problem-solving approach to teaching in agricultural education. When the problem-solving approach to teaching was compared to other teaching approaches, mixed findings were reported. Curbelo (1985), Chiappetta and Russell (1982), and Boone and Newcomb (1990) reported higher student achievement with the problem-solving approach as compared to other teaching approaches. However, Flowers and Osborne (1988) concluded that the problem-solving approach was no more or less effective than the subject matter approach.

The research was mixed regarding the extent that teachers utilized the problem-solving approach in their teaching. Boone and Newcomb (1990) reported that teachers could not distinguish between the problem-solving and subject matter approaches to teaching. In contrast, Chuatong (1986) found
that teachers reported to be engaged in problem-solving behaviors in more than half of their classroom teaching and was supported by Osborne and Hamzah (1989).

Furthermore, the extent that teachers utilized the problem-solving approach in their teaching was found to be related to the extent the problem-solving approach was used during student teaching (Osborne & Hamzah, 1989; McKee & Warmbrod, 1992a, 1992b); teachers' attitude toward using the problem-solving approach (Osborne & Hamzah, 1989); the extent cooperating teachers modeled the problem-solving approach (Osborne & Hamzah, 1989; McKee & Warmbrod, 1992a, 1992b); and the extent the problem-solving approach was emphasized in the preservice teaching course (Osborne & Hamzah, 1989; McKee & Warmbrod, 1992a, 1992b).

Summary of the Problem-Solving Approach To Teaching

The problem-solving approach to teaching has a long historical and philosophical tradition in the teaching of agriculture. Present day authors of textbooks advocating teaching using the problem-solving approach have traced the approach to John Dewey, an educational philosopher of the early 1900s. Dewey's (1910) educational philosophy was to emphasize student centered teaching that enabled students to learn from their personal experiences and problems.

Lancelot was an early promoter of the problem-solving approach to teaching in agricultural education. Lancelot's educational philosophy was that students must be required to
think critically to learn. Lancelot (1944) summarized the problem-solving approach to teaching best by stating that when there was no thinking there was no learning and that the problem-solving approach was a way to teach students to think and subsequently learn.

Cooperating Teachers' Influence on Student Teachers' Teaching Behaviors

The student teaching practicum may have the greatest impact on the teaching skills of the preservice teacher than any other segment of the preservice teacher's preparation program (Zeichner, 1980; Henry & Beasley, 1989). Conant (1963) suggested that the student teaching practicum was "the one indisputably essential element in professional education" (p. 142). However, what person has the greatest impact upon the teaching behaviors of the student teachers?

The cooperating teacher is one of the most significant persons in the preservice teacher's professional development (Brodbelt & Wall, 1985). "The focal point of a successful student teaching experience is the cooperating teacher in whose classroom the student teacher is assigned" (Bennie, 1966, p. 51). Hayes (1966) noted that the cooperating teacher must have the ability to demonstrate effective teaching, guide teaching, and analyze and evaluate teaching.

Grippin (1989) stated that any preservice teacher preparation program depended upon the concept of the cooperating teacher to model the desired teaching behaviors.
Costa and Garmston (1987) suggested that the modeling of teaching skills by the cooperating teacher was one of the major factors contributing to the teaching behaviors of student teachers. Furthermore, it is possible that the cooperating teacher's influence can be so strong to surpass the effect of teaching methods courses (Milner, 1959).

Student teachers have been found to continuously study the cooperating teacher and emulate the cooperating teacher's teaching behaviors (Henry & Beasley, 1989). Student teachers perceive that cooperating teachers will model good teaching. In a study of the significant people who influenced student teachers, Karmos and Jacko (1977) found that 88 percent of student teachers believed that their cooperating teacher was the first or second most influential person in developing their teaching behaviors.

McIntyre (1984) supported the previous finding of Karmos and Jacko (1977) by stating that "...many preservice students view their cooperating teachers as being the most significant influence during their student teaching experience. This influence appears to be most notable in the shaping of students' attitudes and behaviors" (p. 42). Therefore, one can conclude that student teachers will imitate the teaching behaviors, teaching style, and teaching procedures of the cooperating teacher (Brodbelt & Wall, 1985).

Evidence (Brodbelt, 1980) has shown that the teaching model established by the cooperating teacher became the actual
pattern followed by the student teacher. Joyce (1988) reviewed the literature, with regard to modeling by cooperating teachers, and concluded that the evolution of teaching behaviors during the student teaching practicum were the direct result of teaching behaviors modeled by the cooperating teacher. Research (Johnson, 1969; Seperson & Joyce, 1973; Yee, 1969) has shown that the attitudes and behaviors of student teachers shifted toward those of their cooperating teachers by the end of the student teaching practicum. Zimpher, de Voss, and Nott (1980) reported that "... student teachers almost exclusively modeled the teaching of the cooperating teachers ..." (p. 13).

Price (1961) concluded that the student teachers acquired many of the teaching practices of their cooperating teacher, and has been supported by other researchers (Glassberg & Sprinthall, 1980; Zeichner, 1980; Zeichner & Tabachnick, 1981). However, student teachers have been found not to model all the teaching behaviors demonstrated by cooperating teachers. McIntyre, Buell, and Casey (1979) reported that there was no relationship between the verbal behavior of the cooperating teacher and student teacher. Correlations did exist, but were negative and non significant (McIntyre, Buell, & Casey, 1979).

With the cooperating teacher playing such a major role in the student teaching practicum, how much influence does the cooperating teacher have in regard to the use of the problem-
solving approach to teaching? In a study of agriculture preservice teachers, McKee and Warmbrod (1992a) reported that cooperating teachers provided little instruction or supervision in developing the student teacher's knowledge and skill with regard to using the problem-solving approach to teaching. Despite the lack of supervision previously demonstrated by cooperating teachers, will student teachers who have cooperating teachers who utilize the problem-solving approach to teaching in their classroom be more inclined to use the problem-solving approach to teaching during the student teaching practicum?

Learning Style

As individuals, teachers vary in the way they learn and teach (Cornett, 1983). Gregorc (1979) concluded that all individuals had the basic capability to learn and teach, but that all individuals did not learn and teach effectively in the same manner. Researchers (Witkin, 1973; Gregorc, 1979; Garger & Guild, 1984) have suggested that individual learning styles have implications for students' academic achievement, how students learn and teachers teach, and student-teacher interaction.

Studies (Witkin, 1973; Doeblcr & Eicke, 1979; MacNeil, 1980; Mahlios, 1981; Avery, 1985; Frank, 1986; Saracho, 1989; Jacobs, 1990; Marshall, 1991; Cano, Garton, & Raven, 1991; Cano & Garton, 1992) have measured and explained the learning styles of teachers. The conclusion drawn from the previous
research was that not all teachers learn and teach in the same manner.

Is it possible that the teaching approach or method a teacher selects is consistent with his/her learning style? Dunn and Dunn (1979) stated that there was a commonly ascribed to belief that "teachers teach the way they were taught" (p. 241), but that a more accurate statement should be "teachers teach the way they learned" (p. 241). Other researchers (Witkin, 1973; Gregorc, 1979; Avery, 1985) have supported Dunn and Dunn's (1979) statement. Yet, Koppleman (1980) suggested that insufficient investigations have been conducted on the influence of a person's learning style on the manner in which he/she teaches. Furthermore, Cano and Garton (1992) suggested that teacher educators needed to determine the influence that a preservice teacher's learning style had on his/her ability to teach utilizing the problem-solving approach to teaching.

Learning style describes the manner in which a person sorts and processes information. Many educational scholars and researchers (Witkin, 1973; Gordon, 1977; Claxton & Ralston, 1978; Even, 1978; Kirby, 1979; Doepler & Eicke, 1979; Mahlios, 1981; Frank, 1986; Saracho, 1989; Lyons, 1984) have referred to students' learning styles as their cognitive styles. Claxton and Murrell (1987) noted that the term learning style was used in many different ways and that one such term was cognitive style.
Learning style is similar to cognitive style, but the context is more specific. Learning style is "the student's consistent way of responding and using stimuli in the context of learning" (Claxton & Ralston, 1978, p. 1). Therefore, in the current study, learning style and cognitive style were tested as the same.

Several learning style definitions have been provided over the years. Learning style has been described as "individual variations in modes of perceiving, remembering, and thinking, or as distinctive ways of apprehending, storing, transforming, and utilizing information" (Kogan, 1971, p. 244). Della-Dora and Blanchard (1979) further described learning style as "a personally preferred way of dealing with information and experience for learning that crosses content areas" (p. 22).

Garger and Guild (1984) described learning styles as "...stable and pervasive characteristics of an individual, expressed through the interaction of one's behaviors and personality as one approaches a learning task" (p. 11). Even (1978) provided an additional insight to the meaning of learning styles. Even (1978) stated that:

Cognitive [learning] styles, diverse ways of taking in information and processing it, usually develop by 12 years of age and remain rather stable over the years. A style has broad influence on aspects of personality and behavior, perception, memory,
problem solving, interests, and career goals as well as social behavior. (p. 9)

The most widely studied learning style has been the field-dependence/independence dimension and has produced the broadest applications to educational problems (Witkin, Moore, Goodenough, & Cox, 1977; Doebler & Eicke, 1979). Guild and Garger (1985) noted that the work of Witkin and his associates had been the most extensive and indepth research on learning styles in the last 50 years. Witkin (1973) defined the field-dependence/independence learning style dimension as:

The extent to which a person is able to deal with a part of a field separately from the field as a whole, or the extent to which he [sic] is able to disembed items from organized context or, to put it in everyday language, determines how analytical he [sic] is. Because at one extreme of the performance range perception is strongly dominated by the prevailing field, we speak of that mode as "field dependent." For the other extreme, where the person is able to deal with an item independently of the surrounding field, we use the designation "field independent." (p. 5)

Measurement of Field-Dependence/Independence

Over the years, several standardized tests have been developed to measure the field-dependence/independence learning style dimension. Most of the instruments have been
developed for use in individual settings, while one instrument has been developed to be administered in a group setting.

The concept of learning style was originated in the psychological laboratory where Witkin developed the Rod and Frame Test (RFT) to differentiate field-independence and field-dependence (Witkin, Dyk, Faterson, Goodenough, & Karp 1974). In the administration of the Rod and Frame Test, a subject is seated in a darkened room and shown a luminous rod situated in a luminous frame.

The rod and frame can be adjusted independently, and the subject is asked to move the rod to the true vertical position as the frame is tilted. The field-independent person will adjust the rod to a perfect upright position, independent of the frame. The field-dependent person, strongly influenced by the frame or field, will not rotate the rod to a vertical position. The RFT has been found to be a valid (Witkin, 1948; Witkin & Asch, 1948) and reliable (Witkin, 1948; Witkin & Asch, 1948; Oltman, 1964) way of testing for field-dependence and field-independence.

A similar instrument, the Body Adjustment Test (BAT), was developed by Witkin (Witkin, Moore, Goodenough, and Cox (1977). In the Body Adjustment Test, a subject is seated in a chair within a small specially constructed room, both of which can be tilted independently. The subject is then asked to adjust his/her body to the upright position.
A field-dependent person will adjust his/her body to the surrounding tilted room and then report that he/she is sitting in an upright position. Conversely, a field-independent person will adjust his/her body to an upright position independently of the tilted angle of the room. The BAT has been found to be as valid and reliable in testing for field-dependence and field-independence as the RFT (Witkin, 1948, 1949).

With the advancement of research on learning styles, paper and pencil instruments were developed to measure field-dependence/independence. The most familiar of the instruments were the Embedded Figures Test (EFT) (Witkin, Oltman, Raskin, & Karp, 1971) for use with individuals, and the Group Embedded Figures Test (GEFT) (Oltman, Raskin, & Witkin, 1971) to be administered to groups. The subject's task in the Embedded Figures Test and Group Embedded Figures Test was to identify a previously seen simple figure that had been embedded within a larger complex figure.

The ability to locate the simple figure within the complex figure indicated a preference toward field-independence while the inability to locate the simple figure within the complex figure indicated a preference toward field-dependence. The EFT and GEFT are considered standardized instruments and have been tested for validity and reliability (Witkin, Oltman, Raskin, & Karp, 1971).
General Characteristics of Field-Dependence/Independence

Variables have been identified that potentially influence whether a person prefers a field-dependent or field-independent learning style. Gender differences (Witkin, Moore, Goodenough, & Cox, 1977; Cano, 1993) and child rearing experiences (Witkin, 1976) have been linked to the development of a person's field-dependency.

Witkin (1976) noted that the kind of relations that children have had with their mothers was very influential in determining their learning style. Researchers (Witkin, 1976; Tarule & Weathersby, 1976) have found that a person's standing on the field-dependence versus field-independence dimension remained relatively stable from childhood to adulthood. In addition, gender differences have been found on the field-dependence/independence dimension. Females tend to lean more toward the field-dependent learning style than their male counterparts (Witkin, 1976).

Although differences have been found between field-dependent and field-independent learning styles, the two remain independent of intelligence. Researchers (Witkin, 1976; Garger & Guild, 1984) have consistently demonstrated that learning styles are independent of intelligence, therefore the field-dependence/independence dimension appears to be more related to the "how" than to the "how much" of learning (Garger & Guild, 1984).
Witkin, Moore, Oltman, Goodenough, Friedman, Owen and Raskin (1977) noted that the field-dependence/independence dimension was bipolar, in the sense of not having a clear high or low end. By being bipolar the dimension was value neutral. People at each end of the dimension were high in some characteristics and low in others, it was not inherently better or worse to be located toward one pole or the other (Witkin, Moore, Oltman, Goodenough, Friedman, Own, & Raskin, 1977).

Learners preferring the field-dependent learning style, like learners preferring the field-independent style, have their own "preferred style" by which they approach a learning experience. The characteristics and behaviors describing the field-dependent and field-independent learner are at each extreme of the bipolar continuum. Not all field-dependent learners experience the same characteristics and behaviors and not all field-independent learners experience the same characteristics and behaviors. Furthermore, there is no implication that there exist two distinct types of people (Witkin, Moore, Goodenough, & Cox, 1977; Claxton & Murrell, 1987) and one must be cautioned in that one preferred learning style is not superior to another (Witkin, Moore, Goodenough, & Cox, 1977). What are the characteristics and behaviors that describe persons preferring the field-dependent and field-independent learning style?
Field-Dependent Characteristics and Behaviors

Research (Witkin, 1973) has shown that a person whose mode of perception was strongly dominated by the surrounding field was leaning toward a field-dependent learning style. Field-dependent learners perceived the world globally and tended to have a global perception toward learning (Witkin, Moore, Goodenough, & Cox, 1977). Based on their global perception, field-dependent learners find it more difficult to learn when faced with a learning task which encompasses several steps. Field-dependent learners become frustrated with learning when they are unable to "break down" the learning task into smaller segments.

Because of the field-dependent learner's global perception and difficulty in "breaking down" learning tasks, the field-dependent learner does not perform well at analytical problem-solving (Messick, 1970; Cross, 1976; Gordon, 1977; Ronning, McCurdy, & Ballinger, 1984; Calkins & Welkowitz, 1984). When experiencing difficulty in learning tasks that require problem-solving, the field-dependent learner tends to "give up" and become uninterested in the subject matter.

Examples of subject areas that require problem-solving abilities in which field-dependent learners experience difficulty are mathematics and science (Witkin, 1976; Witkin, Moore, Goodenough, & Cox, 1977). Witkin, Moore, Goodenough, and Cox (1977) stated that field-dependent learners needed
more explicit instruction when faced with problem-solving tasks. When necessary, field-dependent learners need to be given more structure and detailed analysis of the problem-solving task.

As previously noted, the kind of relationship that children had with their mothers was influential in establishing a preferred learning style (Witkin, 1976). From early childhood experiences and relations with their mothers, field-dependent learners tended to be highly sensitive and attuned to their social environment (Even, 1982). Based on their social qualities, field-dependent learners tend to have well developed skills in getting along with people and are more responsive to social clues (Cano, 1993).

In addition to being sensitive to social clues, relatively field-dependent persons are drawn to people, in the sense of liking to be with people and being physically close to others (Holley, 1972). Field-dependent learners are perceived by others as warm, tactful, considerate, socially outgoing, and affectionate (Weissenberg & Gruenfeld, 1966). In learning situations, field-dependent learners would prefer to socialize with other learners versus being actively engaged in learning (Cano, 1993).

Because of the socialization factor, field-dependent learners are extrinsically motivated (Witkin, Moore, Goodenough, & Cox, 1977) and favor the "spectator approach" to learning (Cano, 1993). Furthermore, because of the extrinsic
motivation factor, field-dependent learners usually will not become engaged in learning activities unless others are involved or the teacher provides motivation.

Regarding the "spectator approach" to learning, field-dependent learners would prefer to "sit and listen" rather than be actively involved in the learning activity. Field-dependent learners look for the teacher to provide the answers rather than searching for the answers (Cano, 1993). In formal classrooms, field-dependent learners generally do not want the teacher to ask them questions regarding the subject matter. Learning activities preferred by field-dependent learners include small group work (Cano, 1993), general classroom discussions (Witkin, 1976; Ekstrom, 1976), and classroom lectures (Cano, 1993).

Field-dependent learners tend to be highly organized people (Cano, 1993). Organization in the teaching and learning process is important to field-dependent learners. Field-dependent learners require externally defined goals and must be provided with organization in the teaching and learning process (Witkin, Moore, Goodenough, & Cox, 1977). In an effort to learn the subject matter, some field-dependent learners will reorganize the subject matter taught by the teacher to an organizational structure they prefer. Some field-dependent learners will go as far as rewriting their class notes in order to make sense of the subject matter (Cano, 1993).
Field-dependent learners demonstrate behavioral tendencies with their relationships to peers and teachers. Furthermore, relational behaviors between field-dependent learners and teachers can be divided into personal and instructional relationships (Cano, 1993). Regarding relationships with peers, field-dependent learners prefer to work with others in the achievement of common goals (Cano, 1993). Field-dependent learners are sensitive to the feeling and opinions of their peers (Witkin, Moore, Goodenough, & Cox, 1977). Furthermore, when working in peer groups, a concern to the field-dependent learner is that the task is equally divided among all learners and that everyone is sensitive to each others' feeling (Cano, 1993).

In describing personal relationships with teachers, field-dependent learners generally express positive feelings toward the teacher (Cano, 1993). Field-dependent learners view teachers as positive role models, role models to emulate (Cano, 1993). Field-dependent learners are encouraged when teachers use positive reinforcement that expresses support for their accomplishments (Witkin, Moore, Goodenough, & Cox, 1977).

Regarding instructional relationships with the teacher, field-dependent learners continually seek support and guidance from the teacher (Cano, 1993). Field-dependent learners continually seek a close working relationship with the teacher. As a result, the field-dependent learner is highly
motivated when working individually with the teacher (Cano, 1993). Field-dependent learners who receive a greater amount of reinforcement from teachers will be more likely to complete their assignments (Cano, 1993).

How do all the characteristics and behaviors of the field-dependent learning style influence the field-dependent learner's teaching style? More specifically, does a person teach the way he/she learns?

Field-Dependent Teaching Style

Lyons (1984) concluded that there was evidence to support a relationship between a teacher's learning style and teaching style. Dunn and Dunn (1979) further stated that a person's teaching style tended to correspond to how he/she learned. Research (Witkin, 1976; Lyons, 1984) has suggested that a person's learning style did in fact influence his/her teaching style. In addition, Lyons (1984) concluded that there was a consistency in learning and teaching behaviors throughout student teaching. Furthermore, it would appear that teaching styles from student teaching were evident throughout teachers' teaching careers (Lyons, 1984).

From the discussion of field-dependent learning style characteristics and behaviors, "... it is easy to see that a teacher's cognitive [learning] style may influence his [/her] way of teaching" (Witkin, 1976, p. 57). The field-dependent teaching style is consistent with the characteristics and behaviors of the field-dependent learning style (Cano, 1993).
Field-dependent teachers generally are very student-centered, establish a warm personal learning environment, and avoid the use of negative feedback (Witkin, Moore, Goodenough, & Cox, 1977). Field-dependent teachers emphasize social interaction in the teaching and learning process and provide students with a role in the structuring of learning activities (Witkin, Moore, Goodenough, & Cox, 1977; Koppleman, 1980). In addition, field-dependent teachers are socially oriented with their students by encouraging them to work in a cooperative effort.

With regard to student feedback, positive reinforcement is used by field-dependent teachers to strengthen their relationship with students. Everyday the field-dependent teacher will find something "good" to say about each student (Cano, 1993).

Almost on a daily basis, field-dependent teachers like to hold an informal class discussion (Cano, 1993). Although generally not centered on the subject matter of the lesson, the field-dependent teacher uses the informal discussion to motivate the students. Furthermore, field-dependent teachers motivate students by providing opportunities for students to see how the concepts learned in class are related to students' personal experiences (Cano, 1993).

Regarding instruction, field-dependent teachers' lessons are extremely organized and clear with logical steps toward the lessons' objective. The purpose and main concepts of the
lesson are made clear to the students and the field-dependent teacher will do whatever is necessary to ensure that students succeed in his/her class (Koppleman, 1980; Cano, 1993). Field-dependent teachers are sensitive and provide assistance to students who are having difficulty in learning the subject matter. Furthermore, research (Koppleman, 1980) has found field-dependent teachers to be more directive, tended to command more from students in the form of questions or requests and were concerned with maintaining behavioral control in the classroom (Ekstrom, 1976).

Researchers (Mahlios, 1981; Koppleman, 1980; Ekstrom, 1976; Saracho, 1989) have suggested that field-dependent and field-independent individuals approached pedagogical tasks in very different ways. Field-dependent teachers were more often found to interact with their students in small groups or individually (Mahlios, 1981). Furthermore, field-dependent teachers encourage the class or small group to think and work as a single unit (Cano, 1993).

The discussion method of teaching was rated, by field-dependent teachers, as more important to the practice of good teaching than either the lecture or discovery method of teaching (Witkin, Moore, Goodenough, & Cox, 1977). Field-dependent teachers were found to use questioning techniques that predominately checked on student learning, not questions to introduce subject content or follow-up on students' responses (Moore, 1973). In addition, field-dependent
teachers have been found to resort to teaching approaches that were viewed by students as teaching facts (Witkin, Moore, Goodenough, & Cox, 1977).

**Field-Independent Characteristics and Behaviors**

Learners preferring the field-independent learning style, like learners preferring the field-dependent learning style, have their own "preferred style" by which they approach a learning experience. In describing the characteristics and behaviors of the field-independent learner, one must remain cognizant of the fact that one preferred learning style is not superior to the other (Witkin, Moore, Goodenough, & Cox, 1977).

Learners preferring the field-independent learning style tend to have characteristics that are direct opposites of learners preferring the field-dependent learning style (Cano, 1993). Field-independent learners have a well developed perception of discrete parts (Witkin, Moore, Goodenough, & Cox, 1977). Consequently, the field-independent learner is able to separate discrete parts of the picture from the total picture. Because of this ability, field-independent learners find it easier, when compared to field-dependent learners, to accomplish learning tasks that encompasses several steps.

By possessing the ability to separate discrete parts from the total picture, field-independent learners view the world more analytically (Witkin, Moore, Goodenough, & Cox, 1977). Calkins and Welkowitz (1984) stated that analytical
(deductive) ways of thinking were required by an individual in the solving of problems. Consequently, because of their analytical thinking ability, field-independent learners are more adapted to solving problems than field-dependent learners (Even, 1982).

Research (Witkin, 1976; Ronning, McCurdy, & Ballinger, 1984) has suggested that persons preferring a field-independent learning style had an easier time with problem-solving tasks, especially in the solving of mathematical and science based problems. With regard to science based problems, field-independent learners have been found to solve more problems with greater success than field-dependent learners (Ronning, McCurdy, & Ballinger, 1984).

Supporting field-independent learners' problem-solving ability was the study by Calkins and Welkowitz (1984). Calkins and Welkowitz (1984) reported a significant positive correlation between students' problem-solving skills and learning style scores based on the field-dependence/independence dimension. Calkins and Welkowitz (1984) concluded that there was moderate support for field-independent learners being better adapted at problem-solving skills.

Since field-independent learners are more adept at solving problems, it is not surprising to find that they favor an "inquiry" approach to learning and enjoy working on independent studies (Cano, 1993). Because field-independent
learners favor an "inquiry" approach to learning, field-independent learners are proficient at providing their own structure for the learning situation. Field-independent learners have been found to impose structure and have greater achievement on learning activities which lack a clear inherent structure (Witkin, Moore, Goodenough, & Cox, 1977).

Based on the enjoyment of independent studies, field-independent learners would prefer to learn a task through trial and error as opposed to the teacher teaching them the task (Cano, 1993). Furthermore, field-independent learners are able to combine their problem-solving skills, love for inquiry, and enjoyment of independent studies to motivate themselves intrinsically (Witkin, Moore, Goodenough, & Cox, 1977).

Research (Witkin, Moore, Goodenough, & Cox, 1977) has suggested that field-independent learners tended to learn more than field-dependent learners under conditions of intrinsic motivation. Because of the intrinsic motivation factor, field-independent learners do not react to social reinforcement and do not respond to positive reinforcement offered by teachers (Cano, 1993).

Unlike the social characteristics of field-dependent learners, field-independent learners generally are individualistic and insensitive to the needs of others (Cano, 1993). Witkin, Moore, Goodenough, and Cox (1977) stated that field-independent persons were more likely to be aware of
their own needs and feeling as opposed to those of others. Thus, one may conclude that field-independent learners have poorly developed social skills and are more socially independent (Even, 1982; Cano, 1993).

Although field-independent learners are unresponsive to positive reinforcement, they are very competitive persons (Cano, 1993). Field-independent learners are not competitive for the recognition, but for the sake of knowing that they finished the task (Cano, 1993).

Field-independent learners demonstrate behavioral tendencies with their relationships to peers and teachers. Furthermore, relational behaviors between field-independent learners and teachers can be divided into personal and instructional relationships (Cano, 1993). Regarding relationships with peers, field-independent learners prefer to work independently, which is consistent with their unwillingness to socialize (Cano, 1993). As a result, field-independent learners tend to become inattentive to the social environment when working on class assignments and projects. Because of the intrinsic motivation factor, field-independent learners become very competitive and goal oriented and therefore fail to assist their peers on class assignments and projects (Cano, 1993).

Personal relationships between field-independent learners and the teacher are very formal with the interactions generally restricted to the assignments or projects at hand.
Field-independent learners generally avoid any physical contact between them and their teachers (Cano, 1993).

Regarding instructional relationships with the teacher, field-independent learners are usually impatient to begin new assignments and projects (Cano, 1993). Furthermore, field-independent learners like to try assignments and projects without the guidance of the teacher which is consistent with their preference for a trial and error approach to learning (Cano, 1993).

Field-Independent Teaching Style

As with the field-dependent learning and teaching style, the field-independent teaching style is consistent with the characteristics and behaviors of the field-independent learning style. Field-independent teachers tend to have a structured classroom and emphasize a democratic process with students (Ohnmacht, 1968). Although emphasis is placed on a democratic process, field-independent teachers make it clear to students that the teacher is the authority and responsible for "guiding" the learning process, not necessarily "teaching" the students (Witkin, Moore, Goodenough, & Cox, 1977).

Instructional tendencies of a field-independent teacher model the field-independent learning characteristics and behaviors. Teachers with a field-independent learning style generally are more subject-centered rather than student-centered in their teaching (Cano, 1993). Field-independent teachers have been found to place a heavy emphasis on using
the lecture method of teaching (Witkin, 1976; Witkin, Moore, Goodenough, & Cox, 1977). Field-independent teachers tend to emphasize the importance of individual effort and encourage learning through a trial and error approach (Cano, 1993).

Consequently, due to their analytical perspective, field-independent teachers have been found to use an inquiry or problem-solving approach to teaching and learning (Gordon, 1977; Witkin, Moore, Goodenough, & Cox, 1977; Koppleman, 1980; Garger & Guild, 1984). Koppleman (1980) found that when students were faced with problems in completing assignments, field-independent teachers tended to be more analytical by using a problem-solving approach in helping students figure out the problems for themselves. Similarly, Mahlios (1981) found that field-independent teachers initiated a significantly greater number of academic interactions with their students and asked more analysis level questions rather than factual questions.

Witkin, Moore, Goodenough, and Cox (1977) stated that field-independent teachers preferred teaching situations that were impersonal in nature and oriented more toward the cognitive aspects of teaching. Students have perceived field-independent teachers as encouraging them to apply principles and concepts (Witkin, Moore, Goodenough, & Cox, 1977). In contrast, field-dependent teachers have been perceived as teaching facts (Witkin, Moore, Goodenough, & Cox, 1977).
With regard to corrective feedback, field-independent teachers tend to view negative evaluations as an effective teaching technique (Witkin, Moore, Goodenough, & Cox, 1977). Field-independent teachers have been found to provide a greater amount of corrective feedback to their students following students' failures (Mahlios, 1981). Field-independent teachers have reported that an effective way to increase student learning is to inform a student when a response is incorrect and tell the student why it was incorrect (Mahlios, 1981).

**Relationship with Selecting Teaching as a Career**

Learning style is a potential variable influencing students' academic choices and vocational preferences" (Witkin, 1976, p. 39). Therefore, learning style has become a potentially powerful tool for career guidance (Kirby, 1979). Witkin, Moore, Goodenough, and Cox (1977) reported that there was a growing body of evidence on the role of learning style in career differentiation. Witkin, Moore, Goodenough, and Cox (1977) stated that as a general principle:

... relatively field-independent persons, taken as a group, are likely to show interest in domains where their cognitive skill - competence in articulation or in analysis and structuring - are called for and where relations with people are not particularly involved. In contrast, relatively field-dependent persons, as a group, are likely to
favor domains with a "people" emphasis - that is, which feature social content and which involve interpersonal relations in daily ongoing activities - and for which analytical/structuring competence does not particularly matter. (p. 40)

Now then, how has learning style influenced the selection of a career in teaching, more specifically a career in teaching agriculture?

Witkin (1973) stated that those who choose careers in teaching were most likely to be field-dependent learners. Sofman, Hajosy, and Vojtisek (1976) reported that science teachers were significantly more field-independent than liberal arts teachers. A similar study (Witkin, Moore, Oltman, Goodenough, Friedman, Owen, & Raskin, 1977) found that science majors were significantly more field-independent than teacher education majors. Although teacher education majors as a group were relatively field-dependent, there was still a large variation among teacher education majors because specific areas of specialization spread across a number of academic areas (Witkin, Moore, Goodenough, & Cox, 1977).

Witkin, Moore, Goodenough, and Cox (1977) reported that teachers in the areas of mathematics, science, agriculture, and industrial arts have been inclined to be more field-independent. In contrast, teachers in the areas of social science, elementary, and business tended to be more field-dependent learners (Witkin, Moore, Goodenough, & Cox, 1977).
A study (Frank, 1986) of teacher education majors supported the contention that learning style was related to area of specialization among teacher education majors in a manner consistent with the findings of Witkin, Moore, Goodenough, and Cox (1977). The results indicated that teacher education majors in the specialized areas of natural sciences, mathematics, business, and physical education tended to be more field-independent (Frank, 1986). In contrast, teacher education majors specializing in the social sciences, humanities, family and child development, home economics, special education, and speech pathology were inclined to be more field-dependent (Frank, 1986). However, Frank's (1986) study did not include teacher education majors in agriculture.

Research (Cano, Garton, & Raven, 1991; Cano & Garton, 1992) has indicated that preservice teachers of agriculture lean more toward the field-independent learning style. Furthermore, findings indicated that female preservice teachers of agriculture generally preferred the field-independent learning style (Cano, Garton, & Raven, 1991; Cano & Garton, 1992). The findings of Cano, Garton, and Raven (1991) and Cano and Garton (1992) did not support the previous findings that females lean more toward the field-dependent learning style than their male counterparts (Witkin, Oltman, Raskin, & Karp, 1971). From the previously identified studies, it may be concluded that learning style preference
differences do exist among and within teacher preparation specialization areas.

Summary of Learning Styles

Learning style describes the manner in which a person sorts and processes information. The field-dependence/independence learning style dimension has been the most widely studied learning style and has produced the broadest applications to educational problems (Witkin, Moore, Goodenough, & Cox, 1977; Doehler & Eicke, 1979). The field-dependent and field-independent learning styles are concerned more with the "how" of learning than the "how much" (Garger & Guild, 1984). The field-dependent and field-independent learning styles are bipolar dimensions, value neutral, and independent of intelligence.

Field-dependent learners mode of perception is strongly dominated by the surrounding field (Witkin, Moore, Goodenough, & Cox, 1977). In contrast, field-independent learners are relatively uninfluenced by the surrounding field (Witkin, Moore, Goodenough, & Cox, 1977). The characteristics describing the two learning styles tend to denote direct opposites.

Field-dependent persons possess more global perceptions, pay greater attention to social clues and have an interpersonal orientation. In contrast, field-independent persons possess more articulate perceptions, pay less attention to social clues and have an impersonal orientation.
There is evidence to support a relationship between teacher's learning style and teaching style. The field-dependent and field-independent teaching styles are consistent with the characteristics and behaviors of the field-dependent and field-independent learning styles. As with describing the two learning styles, the two teaching styles tend to denote direct opposites.

Field-dependent teachers are student-centered, avoid the use of negative feedback, use positive reinforcement, and prefer the discussion method of teaching over either the lecture or discovery method of teaching. In contrast, field-independent teachers are subject-centered, view negative evaluations as effective, prefer impersonal teaching situations, and prefer an inquiry or problem-solving approach to teaching.

Learning styles are a potentially powerful tool for career guidance. Learning style preferences do exist among and within teacher preparation specialization areas. Both male and female teachers of agriculture were identified as generally preferring a field-independent learning style.

Chapter Summary

The agricultural education profession has promoted the problem-solving approach as the most effective approach for teaching (Martin, 1982). Through the problem-solving approach to teaching, teachers are teaching their students how to think, make decisions, and solve problems (Lancelot, 1944;
Stewart, 1950; Hedges, 1991; AAAE, 1991). The ability to think through and solve problems is an important objective of agricultural education and all of education (Dickerson, 1984).

The historical development of the problem-solving approach to teaching has been traced to the educational philosophy of John Dewey. Many of the present day teacher educators in agriculture have promoted the problem-solving approach to teaching based on Dewey's philosophical views of education.

Similarities exist among the problem-solving approaches to teaching promoted by teacher educators in agriculture. Foremost, there must be problems to be solved based on real problems facing students or potential problems students may face in future careers (Dewey, 1910; Charter, 1912; Stewart, 1950; Rhoad, 1951; Drawbaugh & Hull, 1971; Hedges, 1991). Additionally, students should be engaged in critical thinking and make decisions during the use of the problem-solving approach to teaching (Lancelot, 1944; Stewart, 1950; Hammonds, 1950; Rhoad, 1951; Phipps, 1952, 1965, 1966, 1972, 1980; Binkley & Tulloch, 1981; Phipps & Osborne, 1988; Hedges, 1991).

Research with regard to the problem-solving approach to teaching in agricultural education is inconclusive. When the problem-solving approach to teaching was compared to other teaching approaches, mixed results on student achievement and
retention were found (Flowers, 1988; Flowers & Osborne, 1988; Curbelo, 1985; Boone & Newcomb, 1990).

With regard to teachers' teaching, Boone and Newcomb (1990) concluded that agriculture teachers could not distinguish between a problem-solving approach to teaching or a subject matter approach to teaching. However, McKee and Warmbrod (1992a) found that first-year teachers of agriculture were using the problem-solving approach to teaching, but not exclusively. In addition, teachers of agriculture have reported a high use of the lecture-discussion method of teaching (Osborne & Hamzah, 1989). The extent that teachers utilized the problem-solving approach to teaching was found to be related to the extent the problem-solving approach to teaching was used during student teaching, attitude toward using the approach, and the extent cooperating teachers modeled the approach during student teaching (Osborne & Hamzah, 1989).

With regard to modeling teaching behaviors, Costa and Garmston (1987) suggested that the modeling of teaching skills by cooperating teachers was one of the major factors contributing to the teaching behaviors of student teachers. Furthermore, Milner (1959) suggested that the cooperating teacher's influence can be so strong as to surpass the effect of teaching methods courses. Consequently, the question was raised, will student teachers who have cooperating teachers who utilize the problem-solving approach to teaching be more
inclined to use the problem-solving approach to teaching during the student teaching practicum?

There is a commonly ascribed to belief that teachers tend to teach the way they learn. Teachers' teaching style was found to be influenced by their learning style (Witkin, 1973; Gregorc, 1979; Garger & Guild, 1984). Furthermore, the teaching methods and approaches used by teachers have been linked to their preferred learning style.

The field-dependent and field-independent learning styles have been the most widely studied of the learning style dimensions (Witkin, Moore, Goodenough, & Cox, 1977; Doebler & Eicke, 1979). Evidence exists that links a field-dependent learning style with a field-dependent teaching style and a field-independent learning style with a field-independent teaching style (Lyons, 1984; Witkin, 1976).

However, Witkin, Moore, Goodenough, and Cox (1977) stated that little was known about differences in actual classroom teaching behaviors of more field-dependent and field-independent teachers, and that further research was warranted with classroom teachers. One of the potential differences in student achievement seems to be linked to the teacher's approach to teaching (Witkin, Moore, Goodenough, & Cox, 1977). Therefore, the question should be raised as to whether teachers are able to adopt teaching approaches, other than those nurtured by their own learning style, to better meet the needs of students (Witkin, Moore, Goodenough, & Cox, 1977).
CHAPTER III
METHODOLOGY

Purpose of the Study

The purpose of the study was to test the hypothesized relationships between student teachers' preferred learning styles and problem-solving ability and the extent of use of the problem-solving approach to teaching during the student teaching practicum. The study further sought to test the hypothesized relationship between the extent cooperating teachers utilized the problem-solving approach to teaching and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. In addition, the study sought to describe the teaching methods utilized, by student and cooperating teachers, while using and not using the problem-solving approach to teaching during the student teaching practicum.

Design of the Study

A descriptive-correlation research design was utilized to test the research hypotheses and to accomplish the objectives of the study. Descriptive research techniques were used to portray the incidence, distribution, and characteristics of the subjects' learning style, problem-solving ability, and the
extent that subjects utilized the problem-solving approach to teaching.

Furthermore, descriptive research techniques were used to describe the teaching methods utilized while subjects were using the problem-solving approach to teaching, and the teaching methods utilized while subjects were not using the problem-solving approach to teaching. Correlational procedures were utilized to test the hypothesized relationships between subjects' learning style and problem-solving ability and the extent subjects utilized the problem-solving approach to teaching.

**Population and Sample**

**Student Teachers**

The target population for the study was preservice teachers majoring in agricultural education at The Ohio State University. The accessible sample was preservice agriculture teachers enrolled in Agricultural Education 580, "Student Teaching in Agriculture," at The Ohio State University during the Autumn Quarter, 1992. The accessible sample consisted of 11 male and six female (n = 17) student teachers. The 17 student teachers were preparing for certification to teach production agriculture.

All student teachers had successfully completed Agricultural Education 530, "Methods of Teaching Agriculture," at The Ohio State University during the Spring Quarter, 1991 or Spring Quarter, 1992. "Methods of Teaching Agriculture" is
a course that emphasizes the use of the problem-solving approach to teaching (Appendix A). Furthermore, the 17 student teachers had the opportunity to utilize the problem-solving approach to teaching in eight microteaching practicums that ranged from 15 to 30 minutes in length (Appendix A).

The student teacher responding sample consisted of 10 males and five females (n = 15). One student teacher was deleted from the study because his cooperating teacher had not completed the cooperating teacher seminar prior to Autumn Quarter, 1992. In addition, one student teacher declined to complete the requested videotapes; therefore the student teacher was not included in the study.

Cooperating Teachers

The target population for the study was secondary agriculture teachers in Ohio approved by the Department of Agricultural Education at The Ohio State University to serve as cooperating teachers. The cooperating teacher accessible sample consisted of secondary production agriculture teachers in Ohio who were approved by the faculty in the Department of Agricultural Education at The Ohio State University to serve as cooperating teachers for the student teaching practicum during the Autumn Quarter, 1992. Cooperating teachers were approved by the Department of Agricultural Education faculty based on having met pre-determined criteria such as the school's physical facilities, students enrolled in the agriculture program, students' supervised agricultural
experience programs, FFA program, course of study, and commitment to serving as a cooperating teacher.

The cooperating teacher accessible sample consisted of 13 males (n = 13). Four of the cooperating teachers were assigned the responsibility of supervising two student teachers each.

The cooperating teacher responding sample consisted of 10 males (n = 10). One cooperating teacher was deleted from the study because he had not completed the cooperating teacher seminar prior to Autumn Quarter, 1992. In addition, two cooperating teachers declined to complete the requested videotapes; therefore the two cooperating teachers were not included in the study.

**Instrumentation**

**Group Embedded Figures Test**

The Group Embedded Figures Test (GEFT) (Oltman, Raskin, Witkin, 1971) was used to determine the preferred learning style of the student teachers as either field-dependent or field-independent. The Group Embedded Figures Test (GEFT) is considered a standardized instrument and has been used extensively in educational research (Witkin, Oltman, Raskin, Karp, 1971).

The GEFT contains 18 complex figures, 17 of which were taken from the Embedded Figures Test (EFT). The GEFT contains three sections. The first section contains seven items and is used primarily for practice. Both the second and third
sections contain nine more items which are used for scoring the instrument. The GEFT requires 20 minutes to administer and is scored by using templates provided by the test distributor. Subjects scoring greater than the national norm (11.4) (Witkin, Oltman, Raskin, & Karp, 1971) are considered to be leaning toward the field-independent learning style while subjects scoring less than the national norm are considered to be leaning toward the field-dependent learning style.

The validity of the GEFT has been established by determining its relationship with the parent test (EFT), the Rod and Frame Test (RFT), and the Body Adjustment Test (BAT). The correlation coefficients between the GEFT and the EFT ranged from .84 to .90 (Witkin, Oltman, Raskin, & Karp, 1971). Correlation coefficients between the GEFT and RFT and BAT are substantial, .55 and .71 respectively (Witkin, Oltman, Raskin, & Karp, 1971).

Reliability of the GEFT was established by correlating parallel forms of the test with identical time limits (Witkin, Oltman, Raskin, & Karp, 1971). Correlations between the parallel forms of the test were computed using the Spearman-Brown prophecy formula, resulting in a reliability estimate of .82 for both male and female college students (Witkin, Oltman, Raskin, & Karp, 1971). Furthermore, the reliability of the GEFT compared favorably with the reliability of the parent
test (EFT), which ranged from .79 for female to .82 for male college students (Witkin, Oltman, Raskin, & Karp, 1971).

Cornell Critical Thinking Test, Level Z

The Cornell Critical Thinking Test, Level Z (Ennis & Millman, 1985), was used to determine the problem-solving ability of the student teachers. The Cornell Critical Thinking Test, Level Z (Ennis & Millman, 1985), is considered a standardized instrument.

The Cornell Critical Thinking Test, Level Z, is a 52-item multiple choice test that requires a 50 minute time period to complete. One total score is calculated for the test by taking the number of correct responses minus one-half the number of incorrect responses (Ennis, Millman, & Tomko, 1985). Level Z is intended for advanced and gifted high school students, college students, and adults (Ennis, Millman, Tomko, 1985).

Validity of the Cornell Critical Thinking Test, Level Z, was addressed by the developers of the test (Ennis, Millman, Tomko, 1985). The test developers selected only those items that called for the employment of critical thinking in significant situations that people understood. Only those items that conformed to the definition of critical thinking were selected for the test (Ennis, Millman, & Tomko, 1985).

Two analyses were utilized to determine the reliability of the Cornell Critical Thinking Test, Level Z. The Spearman-Brown reliability coefficients ranged from .55 to .76 and the
Kuder-Richardson reliability scale for internal consistency ranged from .50 to .77 (Ennis, Millman, & Tomko, 1985).

Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory

The Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory (Appendix B) was used to describe the extent that student teachers and cooperating teachers utilized the problem-solving approach to teaching. The Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory was developed by Garton and Cano (1992) and consisted of 10 procedures that represented a teacher's extent of use of the problem-solving approach to teaching. In addition, the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory identified teaching methods utilized in the teaching/learning process, either while using the problem-solving approach to teaching, or while not using the problem-solving approach to teaching.

The 10 problem-solving procedures were identified from Boone's (1988) list of the 10 essential elements of the problem-solving approach to teaching and a review of the literature on the problem-solving approach to teaching. Boone's (1988) 10 essential elements of the problem-solving approach to teaching and subsequent approach to teaching instrument have been utilized by other researchers (McKee,
1991; McKee & Warmbrod, 1992a, 1992b). The teaching methods identified in the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory were recognized as teaching methods utilized in the teaching of agriculture (Newcomb, McCracken, & Warmbrod, 1986).

Videotapes of the student teachers' and cooperating teachers' "classroom" teaching were analyzed using the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory. At one minute intervals, teachers were identified as either using the problem-solving approach to teaching or not using the problem-solving approach to teaching. Teachers found to be using the problem-solving approach to teaching during the one minute intervals were coded numerically (1-10) according to one of the 10 problem-solving approach to teaching procedures (Appendix B).

Furthermore, the teaching methods that were utilized in the teaching/learning process were identified (Appendix B). At one minute intervals, the teaching methods utilized during the teaching/learning process were coded numerically (1-7) (Appendix B). Teaching methods utilized during the problem-solving approach to teaching had a corresponding problem-solving approach procedure numerical code (1-10). Teaching methods utilized while not using the problem-solving approach
to teaching did not have a corresponding numerical code in the problem-solving approach procedure coding space.

At the conclusion of the "classroom" teaching episode, the total number of minutes in the class period was determined. The total number of minutes was used to calculate the percentage of time that the teachers spent utilizing the problem-solving approach to teaching. Furthermore, the percentage of time that teachers spent on each of the 10 problem-solving approach to teaching procedures was calculated (Summary Sheet, Problem-Solving Approach To Teaching Procedures, Appendix B). In addition, the percentage of instructional time spent utilizing the teaching methods during the problem-solving approach to teaching and not during the problem-solving approach to teaching were calculated (Summary Sheet, Teaching Methods Utilized, Appendix B).

The instrument, Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory, was assessed for validity by a panel of experts, consisting of teacher educators in agriculture, who were considered to be knowledgeable on the problem-solving approach to teaching (Appendix C). Revisions were made to the instrument based upon the recommendations suggested by the panel of experts.

Reliability of the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory was dependent upon the raters' utilization of the
instrument. A single rater, the researcher, was utilized in the study. Therefore, reliability of the instrument was established by assessing the intra-rater reliability of the instrument.

Intra-rater reliability was established utilizing 10 microteaching videotapes from Agricultural Education 530, "Methods of Teaching Agriculture." Prior to the analysis of the videotapes of the student teachers and cooperating teachers, the 10 microteaching videotapes were analyzed using the instrument. A reanalysis of the microteaching videotapes was conducted 14 days after the initial analysis. To add further support to the intra-rater reliability, 10 randomly selected teachings from the student teachers' and cooperating teachers' actual data videotapes were reanalyzed.

To assess the intra-rater reliability of the instrument a coefficient of stability was calculated for each of the 10 problem-solving approach to teaching procedures and the total problem-solving approach to teaching score. In addition, a coefficient of stability was calculated for each of the teaching methods utilized while using the problem-solving approach to teaching and each of the teaching methods utilized while not using the problem-solving approach to teaching.

The resulting coefficients of stability for the 10 problem-solving approach to teaching procedures, for the 10 microteaching videotapes, ranged from .90 for the "teacher was leading students in defining a clear statement of the problem"
to .99 for four of the remaining nine procedures (Table 1). No data were available to compute coefficients for three of the problem-solving approach to teaching procedures. The resulting coefficient of stability for the total score on the problem-solving approach to teaching was .99 (Table 1).

For the 10 actual data videotapes, the coefficients of stability for the 10 problem-solving approach to teaching procedures ranged from .96 for the "teacher was leading students in defining a clear statement of the problem" to .99 for seven of the remaining nine procedures (Table 1). No data were available to compute coefficients for two of the problem-solving approach to teaching procedures. The resulting coefficient of stability for the total score on the problem-solving approach to teaching was .99 (Table 1).

Coefficients of stability for the teaching methods utilized while using the problem-solving approach to teaching were .99 for the "lecture/discussion," "demonstration," "supervised study," and "other" teaching methods for the 10 microteaching videotapes (Table 2). No data were available to compute coefficients for the "experiment" and "role play" teaching methods and "idle time." For the 10 actual data videotapes, coefficients of stability were .99 for the "lecture/discussion" and "supervised study" teaching methods (Table 2). No data were available to compute coefficients for the remaining teaching methods and "idle time."
<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Microteaching Tapes (n = 10)</th>
<th>Reanalysis of Actual Tapes (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>.99</td>
<td>.99</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>.96</td>
<td>ND</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>.90</td>
<td>.96</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>ND</td>
<td>.99</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>.95</td>
<td>.99</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>.99</td>
<td>.99</td>
</tr>
</tbody>
</table>
Table 1 (continued)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Microteaching Tapes (n = 10)</th>
<th>Reanalysis of Actual Tapes (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
<td>.99</td>
<td>.99</td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>.99</td>
<td>.99</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>ND</td>
<td>.99</td>
</tr>
<tr>
<td>Total score for the problem-solving approach to teaching.</td>
<td>.99</td>
<td>.99</td>
</tr>
</tbody>
</table>

Note. ND = No data available to compute coefficient
Table 2

Intra-Rater Reliability Coefficients for Teaching Methods Utilized While Using the Problem-Solving Approach To Teaching

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Microteaching Tapes (n = 10)</th>
<th>Reanalysis of Actual Tapes (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>.99</td>
<td>.99</td>
</tr>
<tr>
<td>Demonstration</td>
<td>.99</td>
<td>ND</td>
</tr>
<tr>
<td>Experiment</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>.99</td>
<td>.99</td>
</tr>
<tr>
<td>Role Play</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Other</td>
<td>.99</td>
<td>ND</td>
</tr>
<tr>
<td>Idle Time</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

Note. ND = No data available to compute coefficient

Coefficients of stability for the teaching methods utilized while not using the problem-solving approach to teaching were .99 for the "lecture/discussion" teaching method and .82 for "idle time" on the 10 microteaching videotapes (Table 3). No data were available to compute coefficients for the remaining teaching methods. With regard to the 10 actual data tapes, coefficients of stability were .99 for the "lecture/discussion," "supervised study," and "other" teaching methods and .89 for "idle time" (Table 3). No data were available to compute coefficients for the three remaining teaching methods.
Table 3

Intra-Rater Reliability Coefficients for Teaching Methods Utilized While Not Using the Problem-Solving Approach To Teaching

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Microteaching Tapes (n = 10)</th>
<th>Reanalysis of Actual Tapes (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>.99</td>
<td>.99</td>
</tr>
<tr>
<td>Demonstration</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Experiment</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>ND</td>
<td>.99</td>
</tr>
<tr>
<td>Role Play</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Other</td>
<td>ND</td>
<td>.99</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.82</td>
<td>.89</td>
</tr>
</tbody>
</table>

Note. ND = No data available to compute coefficient

Data Collection

At the beginning of the student teaching practicum, the student teachers and cooperating teachers were contacted by letter and asked to participate in the study (Appendix D and Appendix E). Five days after the mailing, follow-up phone calls were made to each student teacher and cooperating teacher to personally request their participation in the study. During the follow-up phone calls, the researcher had the opportunity to verify the procedures of the study with the subjects.
The Group Embedded Figures Test (GEFT) was administered to student teachers during the quarter of enrollment in Agricultural Education 530, "Methods of Teaching Agriculture." The Cornell Critical Thinking Test, Level Z, was administered to student teachers during the second student teacher seminar that was held on The Ohio State University campus during the student teaching practicum. Procedures for administration of the tests as outlined in the Group Embedded Figures Test Manual (Witkin, Oltman, Raskin, & Karp, 1971) and the Cornell Critical Thinking Tests Level X & Level Z Manual (Third Edition) (Ennis, Millman, & Tomko, 1985) were followed.

To determine the extent that the problem-solving approach to teaching was utilized during the student teaching practicum, student teachers and cooperating teachers were asked to videotape three separate class periods of their "classroom" teaching. Specific directions were provided on the procedures to follow in videotaping the "classroom" teaching (Appendix F and Appendix G).

Each of the three class periods were to range from 40 minutes to one hour in length. Each student teacher and cooperating teacher was provided with two VHS videotapes to record the three "classroom" teachings. Student teachers and cooperating teachers were requested to obtain a videocamera from their school or contact the researcher so arrangements could be made to locate a videocamera.
Directions stated that the videocamera was to be set up prior to the beginning of the class period. Furthermore, the videocamera was to be located in the back of the classroom to ensure as little disruption as possible to the secondary agriculture students. To videotape the class period, student teachers and cooperating teachers were instructed to focus the videocamera on as wide an angle as possible and to turn the videocamera on at the beginning of the class period or prior to the students' arrival.

Student teachers were requested to videotape one class period of their teaching during the third, sixth, and ninth weeks of the student teaching practicum (Appendix F). Cooperating teachers were requested to videotape one class period of their teaching during the first, second, and third weeks of the student teaching practicum (Appendix H).

At the conclusion of the Autumn Quarter, 1992, videotapes from the student teachers and cooperating teachers were analyzed by the researcher. The subjects' three class periods of "classroom" teaching were analyzed separately using the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory.

Data Analysis

All data were analyzed utilizing the SPSS/PC+ computer program. The alpha level was established a priori at .05. The magnitude of relationships reported were interpreted using Davis' (1971) descriptors.
<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Description of Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>.70 or greater</td>
<td>Very Strong</td>
</tr>
<tr>
<td>.50 to .69</td>
<td>Substantial</td>
</tr>
<tr>
<td>.30 to .49</td>
<td>Moderate</td>
</tr>
<tr>
<td>.10 to .29</td>
<td>Low</td>
</tr>
<tr>
<td>.01 to .09</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

A description of the statistical procedures used to test each research hypothesis and to accomplish each research objective follows:

**Research Hypotheses of the Study**

**Hypothesis 1:**

The more field-independent the student teachers' learning style, the greater their problem-solving ability.

The mean, standard deviation, and range was calculated on student teachers' Group Embedded Figures Test (GEFT) scores. Based on the GEFT scores, student teachers were categorized as preferring either a field-dependent learning style or field-independent learning style. Frequencies and percentages of field-dependent and field-independent learning styles were calculated to describe the preferred learning style of student teachers.

Percentages, mean, standard deviation, and range were calculated on student teachers' Cornell Critical Thinking Test, Level Z, scores to describe the problem-solving ability of the student teachers.
To test the hypothesis, a Pearson product-moment correlation coefficient was used to determine the relationship between the preferred learning style of student teachers and their problem-solving ability. To use a Pearson product-moment correlation coefficient, raw scores on the GEFT were considered as interval data and correlated with raw scores on the Cornell Critical Thinking Test, Level Z, also considered interval data.

The null hypothesis was: \( H_0: \rho = 0 \)

The research hypothesis was: \( H_1: \rho > 0 \)

Hypothesis 2:

The more field-independent the student teachers' learning style, the greater their extent of use of the problem-solving approach to teaching during the student teaching practicum.

Means, standard deviations, and ranges were calculated on the total percentage of instructional time student teachers spent using the problem-solving approach to teaching and the percentage of instructional time spent on each of the 10 problem-solving approach to teaching procedures.

To test the hypothesis, a Pearson product-moment correlation coefficient was used to determine the relationship between the preferred learning style of student teachers and the extent student teachers utilized the problem-solving approach to teaching. To use a Pearson product-moment
correlation coefficient, raw scores on the GEFT were considered as interval data and correlated with the total score of the problem-solving approach to teaching, also considered interval data.

The null hypothesis was: \( H_0: \rho = 0 \)

The research hypothesis was: \( H_1: \rho > 0 \)

**Hypothesis 3:**

The greater the extent cooperating teachers utilize the problem-solving approach to teaching, the greater the extent student teachers utilize the problem-solving approach to teaching during the student teaching practicum.

Means, standard deviations, and ranges were calculated on the total percentage of instructional time cooperating teachers spent using the problem-solving approach to teaching and the percentage of instructional time spent on each of the 10 problem-solving approach to teaching procedures.

To test the hypothesis, a Pearson product-moment correlation coefficient was used to determine the relationship between the extent cooperating teachers utilized the problem-solving approach to teaching and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. To use a Pearson product-moment correlation coefficient the cooperating teachers' and student
teachers' total problem-solving approach to teaching scores were treated as interval data.

The null hypothesis was: \( H_0: \rho = 0 \)

The research hypothesis was: \( H_1: \rho > 0 \)

**Objectives of the Study**

**Objective 1:**

To describe the teaching methods utilized by student teachers, while using the problem-solving approach to teaching.

Means, standard deviations, and ranges were calculated on the percentage of instructional time spent using each of the teaching methods while using the problem-solving approach to teaching.

**Objective 2:**

To describe the teaching methods utilized by student teachers, while not using the problem-solving approach to teaching.

Means, standard deviations, and ranges were calculated on the percentage of instructional time spent using each of the teaching methods while not using the problem-solving approach to teaching.

**Objective 3:**

To describe the teaching methods utilized by cooperating teachers, while using the problem-solving approach to teaching.
Means, standard deviations, and ranges were calculated on the percentage of instructional time spent using each of the teaching methods while using the problem-solving approach to teaching.

Objective 4:

To describe the teaching methods utilized by cooperating teachers, while not using the problem-solving approach to teaching.

Means, standard deviations, and ranges were calculated on the percentage of instructional time spent using each of the teaching methods while not using the problem-solving approach to teaching.
CHAPTER IV
FINDINGS

Purpose of the Study

The purpose of the study was to test the hypothesized relationships between student teachers' preferred learning styles and problem-solving ability and the extent of use of the problem-solving approach to teaching during the student teaching practicum. The study further sought to test the hypothesized relationship between the extent cooperating teachers utilized the problem-solving approach to teaching and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. In addition, the study sought to describe the teaching methods utilized, by student and cooperating teachers, while using and not using the problem-solving approach to teaching during the student teaching practicum.

Limitations of the Study

The study was descriptive and relational in nature. A relational study cannot establish cause-and-effect relationships among variables (Borg & Gall, 1989). Therefore, the study sought only to describe characteristics and to test
hypothesized relationships among characteristics. The data in the study were collected utilizing two standardized instruments and one developed by Garton and Cano (1992) (Appendix B).

Accessible samples of agriculture student teachers and cooperating teachers were selected to participate in the study. Consequently, the generalizability of the results was limited to the accessible samples.

Learning Styles of Student Teachers

The data indicated that 33 percent (5) of the student teachers preferred a field-dependent learning style and 67 percent (10) preferred a field-independent learning style (Table 4). A gender analysis revealed that 60 percent (3) of the females preferred a field-dependent learning style and 40 percent (2) preferred a field-independent learning style.

Twenty percent (2) of the males preferred a field-dependent learning and 80 percent (8) preferred a field-independent learning style. Student teachers' scores on the Group Embedded Figures Test ranged from a minimum of seven to a maximum of 17, with a mean score of 13.2, and a standard deviation of 3.5.
Table 4

**Preferred Learning Styles of Student Teachers as Measured by the Group Embedded Figures Test (n = 15)**

| Preferred Learning Style | Females | | Males | | Total | |
|--------------------------|---------| |-------| |-------| |-------|
|                          | f  | %  | f  | %  | f  | %  |
| Field-Dependence         | 3  | 60.0 | 2  | 20.0 | 5  | 33.3 |
| Field-Independence       | 2  | 40.0 | 8  | 80.0 | 10 | 66.7 |
| Total                    | 5  | 100.0 | 10 | 100.0 | 15 | 100.0 |

Mean = 13.2  
S.D. = 3.5  
Range = 7.0 - 17.0

**Problem-Solving Ability of Student Teachers**

Student teachers' problem-solving ability, as assessed by the Cornell Critical Thinking Test, Level Z, scores ranged from zero to 29.5 (Table 5). The student teachers' mean score on the Cornell Critical Thinking Test, Level Z was 16.1, with a standard deviation of 6.9. Forty percent (6) of the student teachers' scores were in the 15.0 to 19.9 range. Furthermore, 73 percent (11) of the student teachers scored below 20.0 on the Cornell Critical Thinking Test, Level Z.
Table 5

Student Teachers' Problem-Solving Ability as Measured by the Cornell Critical Thinking Test, Level Z (n = 15)

<table>
<thead>
<tr>
<th>Scores</th>
<th>f</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4.9</td>
<td>1</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>5.0 - 9.9</td>
<td>1</td>
<td>6.7</td>
<td>13.4</td>
</tr>
<tr>
<td>10.0 - 14.9</td>
<td>3</td>
<td>20.0</td>
<td>33.4</td>
</tr>
<tr>
<td>15.0 - 19.9</td>
<td>6</td>
<td>40.0</td>
<td>73.4</td>
</tr>
<tr>
<td>20.0 - 24.9</td>
<td>3</td>
<td>20.0</td>
<td>93.4</td>
</tr>
<tr>
<td>25.0 - 29.5</td>
<td>1</td>
<td>6.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Mean = 16.1  
S.D. = 6.9  
Range = 0 - 29.5

Research Hypothesis One

The more field-independent the student teachers' learning style, the greater their problem-solving ability.

The null hypothesis was:  \( H_0: \rho = 0 \)

The research hypothesis was:  \( H_1: \rho > 0 \)

To test the null hypothesis, a Pearson product-moment correlation coefficient was calculated between the preferred learning style of student teachers and their problem-solving ability. A low negative, non-significant correlation (\( r = \))
-.25, p > .05) was found between student teachers' preferred learning style and their problem-solving ability (Table 6; Figure 2). Therefore, failing to reject the null hypothesis; that, in the population, the relationship between student teachers' preferred learning style and their problem-solving ability was equal to zero.

Table 6

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>Problem-Solving Ability</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-.25</td>
<td>.37</td>
</tr>
</tbody>
</table>
Extent of Use of the Problem-Solving Approach To Teaching by Student Teachers

To determine the extent that student teachers utilized the problem-solving approach to teaching, during the student teaching practicum, three separate class periods of their "classroom" teaching were analyzed. In addition, the three separate class periods of "classroom" teaching were summed to obtain total scores for the three observations.

First Observation

During the first observation, an average of 17 percent of the student teachers' instructional time was spent utilizing the problem-solving approach to teaching (Table 7). Student
<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>4.4</td>
<td>9.7</td>
<td>0 - 33.3</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>.5</td>
<td>1.3</td>
<td>0 - 4.7</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>.3</td>
<td>1.3</td>
<td>0 - 5.0</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>7.6</td>
<td>16.4</td>
<td>0 - 52.4</td>
</tr>
<tr>
<td>Problem-Solving Procedures</td>
<td>Mean</td>
<td>S.D.</td>
<td>Range</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------------</td>
<td>------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
<td>1.9</td>
<td>7.4</td>
<td>.0 - 28.6</td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>.6</td>
<td>1.9</td>
<td>.0 - 7.1</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>1.3</td>
<td>5.2</td>
<td>.0 - 20.0</td>
</tr>
<tr>
<td>Total score for the problem-solving approach to teaching.</td>
<td>16.7</td>
<td>27.3</td>
<td>.0 - 71.4</td>
</tr>
</tbody>
</table>
teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 71 percent, with a standard deviation of 27.3.

With regard to the 10 problem-solving approach to teaching procedures, student teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "guiding students in seeking data and information needed to analyze potential solutions to the problem" (mean = 7.6). Student teachers spent no time utilizing three of the remaining nine problem-solving approach to teaching procedures.

Second Observation

During the second observation, an average of 23 percent of the student teachers' instructional time was spent utilizing the problem-solving approach to teaching (Table 8). Student teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 100 percent, with a standard deviation of 36.8.

With regard to the 10 problem-solving approach to teaching procedures, student teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "guiding students in seeking data and information needed to analyze potential solutions to the problem" (mean = 10.9). Student teachers spent no time utilizing four of the remaining nine problem-solving approach to teaching procedures.
### Table 8

**Percentage of Instructional Time Student Teachers Spent Using the Problem-Solving Approach To Teaching During the Second Observation** \((n = 15)\)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>3.1</td>
<td>7.8</td>
<td>0 - 28.6</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>1.6</td>
<td>3.2</td>
<td>0 - 10.5</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>.4</td>
<td>1.4</td>
<td>0 - 5.3</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>1.3</td>
<td>3.4</td>
<td>0 - 10.5</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>10.9</td>
<td>20.4</td>
<td>0 - 58.8</td>
</tr>
</tbody>
</table>
Table 8 (continued)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a</td>
<td>5.8</td>
<td>12.2</td>
<td>.0 - 35.2</td>
</tr>
<tr>
<td>solution to the problem.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Total score for the problem-solving approach to teaching.</td>
<td>23.1</td>
<td>36.8</td>
<td>.0 - 100.0</td>
</tr>
</tbody>
</table>
Third Observation

During the third observation, an average of 14 percent of the student teachers' instructional time was spent utilizing the problem-solving approach to teaching (Table 9). Student teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 100 percent, with a standard deviation of 29.8.

With regard to the 10 problem-solving approach to teaching procedures, student teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "assisting students in analyzing the data and information to determine a solution to the problem" (mean = 4.8). Student teachers spent no time utilizing two of the remaining nine problem-solving approach to teaching procedures.
<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>1.4</td>
<td>2.9</td>
<td>0 - 8.6</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>.7</td>
<td>1.9</td>
<td>0 - 6.0</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>1.7</td>
<td>4.7</td>
<td>0 - 17.1</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>.6</td>
<td>1.8</td>
<td>0 - 6.5</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>3.8</td>
<td>10.1</td>
<td>0 - 34.0</td>
</tr>
</tbody>
</table>
Table 9 (continued)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
<td>4.8</td>
<td>13.5</td>
<td>.0 - 48.0</td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>.5</td>
<td>1.7</td>
<td>.0 - 6.5</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>.2</td>
<td>.6</td>
<td>.0 - 2.2</td>
</tr>
</tbody>
</table>

Total score for the problem-solving approach to teaching. 13.7 29.8 .0 - 100.0
Total of the Three Observations

Total scores of the three observations, for the student teachers' "classroom" teaching, indicated that an average of 18 percent of the student teachers' instructional time was spent utilizing the problem-solving approach to teaching (Table 10). Student teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 75 percent, with a standard deviation of 20.9.

With regard to the 10 problem-solving approach to teaching procedures, student teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "guiding students in seeking data and information needed to analyze potential solutions to the problem" (mean = 7.4). Student teachers spent no time utilizing the problem-solving approach to teaching procedures "organizing instruction around solvable problem statements" and "guiding students in applying the solutions and/or recommendations to the problem."

### Table 10

**Total of the Three Observations of the Percentage of Instructional Time Student Teachers Spent Using the Problem-Solving Approach To Teaching (n = 15)**

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>2.9</td>
<td>4.7</td>
<td>.0 - 15.6</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>1.0</td>
<td>1.5</td>
<td>.0 - 4.7</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>.6</td>
<td>1.6</td>
<td>.0 - 5.5</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>.8</td>
<td>1.4</td>
<td>.0 - 4.7</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>7.4</td>
<td>9.3</td>
<td>.0 - 26.6</td>
</tr>
<tr>
<td>Problem-Solving Procedures</td>
<td>Mean</td>
<td>S.D.</td>
<td>Range</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------------</td>
<td>------</td>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
<td>4.0</td>
<td>7.9</td>
<td>0 - 26.6</td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>.4</td>
<td>1.2</td>
<td>0 - 4.5</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>0 - .0</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>.6</td>
<td>2.0</td>
<td>0 - 7.8</td>
</tr>
<tr>
<td>Total score for the problem-solving approach to teaching.</td>
<td>17.6</td>
<td>20.9</td>
<td>0 - 75.0</td>
</tr>
</tbody>
</table>
Research Hypothesis Two

The more field-independent the student teachers' learning style, the greater their extent of use of the problem-solving approach to teaching during the student teaching practicum.

The null hypothesis was: \( H_0: \rho = 0 \)

The research hypothesis was: \( H_1: \rho > 0 \)

To test the null hypothesis, a Person product-moment correlation coefficient was calculated between the preferred learning style of student teachers and the student teachers' total score, for the three "classroom" observations, on the problem-solving approach to teaching. A substantial negative, non-significant correlation \( (r = -.66, p > .05) \) was found between student teachers' preferred learning style and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum (Table 11; Figure 3). Therefore, failing to reject the null hypothesis; that, in the population, the relationship between student teachers' preferred learning style and the extent they utilized the problem-solving approach to teaching during the student teaching practicum was equal to zero.
Table 11

Relationship Between Student Teachers' Preferred Learning Style and the Extent They Utilized the Problem-Solving Approach to Teaching (n = 15)

<table>
<thead>
<tr>
<th>Learning Style (GEFT Scores)</th>
<th>Extent of Use of the Problem-Solving Approach To Teaching</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- .66</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>

**Figure 3.** Relationship Between Student Teachers' Preferred Learning Style (GEFT Scores) and the Extent They Utilized the Problem-Solving Approach To Teaching (n = 15)
Extent of Use of the Problem-Solving Approach to Teaching by Cooperating Teachers

To determine the extent that cooperating teachers utilized the problem-solving approach to teaching, during the student teaching practicum, three separate class periods of their "classroom" teaching were analyzed. In addition, the three separate class periods of "classroom" teaching were summed to obtain a total scores for the three observations.

First Observation

During the first observation, an average of 24 percent of the cooperating teachers' instructional time was spent utilizing the problem-solving approach to teaching (Table 12). Cooperating teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 95 percent, with a standard deviation of 33.8.

With regard to the 10 problem-solving approach to teaching procedures, cooperating teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "gaining and maintaining the interest of the students in learning the subject matter" (mean = 14.7). Cooperating teachers spent no time utilizing six of the remaining nine problem-solving approach to teaching procedures.
Table 12

Percentage of Instructional Time Cooperating Teachers Spent Using the Problem-Solving Approach To Teaching During the First Observation (n = 10)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>14.7</td>
<td>23.6</td>
<td>.0 - 70.6</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>.3</td>
<td>.9</td>
<td>.0 - 2.8</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>1.7</td>
<td>5.3</td>
<td>.0 - 16.7</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>7.5</td>
<td>23.7</td>
<td>.0 - 75.0</td>
</tr>
</tbody>
</table>
Table 12 (continued)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Total score for the problem-solving approach to teaching.</td>
<td>24.2</td>
<td>33.8</td>
<td>.0 - 94.5</td>
</tr>
</tbody>
</table>
Second Observation

During the second observation, an average of 19 percent of the cooperating teachers' instructional time was spent utilizing the problem-solving approach to teaching (Table 13). Cooperating teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 96 percent, with a standard deviation of 33.6.

With regard to the 10 problem-solving approach to teaching procedures, cooperating teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "gaining and maintaining the interest of the students in learning the subject matter" (mean = 7.2). Cooperating teachers spent no time utilizing four of the remaining nine problem-solving approach to teaching procedures.
Table 13

Percentage of Instructional Time Cooperating Teachers Spent Using the Problem-Solving Approach To Teaching During the Second Observation (n = 10)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>7.2</td>
<td>15.7</td>
<td>.0 - 48.6</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>1.1</td>
<td>2.5</td>
<td>.0 - 6.8</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Problem-Solving Procedures</td>
<td>Mean</td>
<td>S.D.</td>
<td>Range</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------------</td>
<td>------</td>
<td>-------</td>
<td>---------</td>
</tr>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
<td>5.2</td>
<td>16.5</td>
<td>.0 - 52.3</td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>3.0</td>
<td>6.8</td>
<td>.0 - 20.5</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>.7</td>
<td>2.2</td>
<td>.0 - 7.0</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>2.1</td>
<td>4.4</td>
<td>.0 - 11.4</td>
</tr>
<tr>
<td>Total score for the problem-solving approach to teaching.</td>
<td>19.3</td>
<td>33.6</td>
<td>.0 - 95.5</td>
</tr>
</tbody>
</table>

Table 13 (continued)
Third Observation

During the third observation, an average of nine percent of the cooperating teachers' instructional time was spent utilizing the problem-solving approach to teaching (Table 14). Cooperating teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 49 percent, with a standard deviation of 16.8.

With regard to the 10 problem-solving approach to teaching procedures, cooperating teachers spent all of their time using the problem-solving approach to teaching procedure "gaining and maintaining the interest of the students in learning the subject matter" (mean = 9.4). Cooperating teachers spent no time utilizing the remaining nine problem-solving approach to teaching procedures during the third observation.
Table 14

Percentage of Instructional Time Cooperating Teachers Spent Using the Problem-Solving Approach To Teaching During the Third Observation (n = 9)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>9.4</td>
<td>16.8</td>
<td>0 - 48.8</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>0</td>
<td>0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>0</td>
<td>0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>0</td>
<td>0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>0</td>
<td>0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>0</td>
<td>0</td>
<td>0 - 0</td>
</tr>
</tbody>
</table>
Table 14 (continued)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
</tbody>
</table>

Total score for the problem-solving approach to teaching. 9.4 16.8 .0 - 48.8
**Total of the Three Observations**

Total scores of the three observations, for the cooperating teachers' "classroom" teaching, indicated that an average of 18 percent of the cooperating teachers' instructional time was spent utilizing the problem-solving approach to teaching (Table 15). Cooperating teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 79 percent, with a standard deviation of 25.3.

With regard to the 10 problem-solving approach to teaching procedures, cooperating teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "gaining and maintaining the interest of the students in learning the subject matter" (mean = 11.0). Cooperating teachers spent no time utilizing the problem-solving approach to teaching procedures "organizing instruction around solvable problem statements" and "drawing possible solutions to the problem from the students."
<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
<td>11.0</td>
<td>12.0</td>
<td>.0 - 33.8</td>
</tr>
<tr>
<td>2. Teacher and students were organizing instruction around solvable problem statements.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>3. Teacher was leading students in defining a clear statement of the problem.</td>
<td>.5</td>
<td>1.1</td>
<td>.0 - 3.3</td>
</tr>
<tr>
<td>4. Teacher was drawing possible solutions to the problem from the students.</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
<td>.5</td>
<td>1.6</td>
<td>.0 - 5.0</td>
</tr>
<tr>
<td>6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
<td>2.2</td>
<td>7.1</td>
<td>.0 - 22.3</td>
</tr>
</tbody>
</table>
Table 15 (continued)

<table>
<thead>
<tr>
<th>Problem-Solving Procedures</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
<td>1.9</td>
<td>6.0</td>
<td>.0 - 19.0</td>
</tr>
<tr>
<td>8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
<td>1.1</td>
<td>2.4</td>
<td>.0 - 7.4</td>
</tr>
<tr>
<td>9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
<td>.2</td>
<td>.8</td>
<td>.0 - 2.4</td>
</tr>
<tr>
<td>10. Teacher was leading students in evaluating the results of the solution to the problem.</td>
<td>.7</td>
<td>1.6</td>
<td>.0 - 4.1</td>
</tr>
<tr>
<td><strong>Total score for the problem-solving approach to teaching.</strong></td>
<td><strong>18.2</strong></td>
<td><strong>25.3</strong></td>
<td><strong>.0 - 79.3</strong></td>
</tr>
</tbody>
</table>
Research Hypothesis Three

The greater the extent cooperating teachers utilize the problem-solving approach to teaching, the greater the extent student teachers utilize the problem-solving approach to teaching during the student teaching practicum.

The null hypothesis was: \( H_0: \rho = 0 \)

The research hypothesis was: \( H_1: \rho > 0 \)

To test the null hypothesis, a Person product-moment correlation coefficient was calculated between the cooperating teachers' total score, for the three "classroom" observations, on the problem-solving approach to teaching and the student teachers' total score, for the three "classroom" observations, on the problem-solving approach to teaching. A substantial positive, significant correlation (\( r = .66, p < .05 \)) was found between the extent cooperating teachers and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum (Table 16; Figure 4). Therefore, the null hypothesis was rejected and the research hypothesis was accepted as being tenable; that, in the population, the relationship between the extent cooperating teachers and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum was greater than zero.
Table 16

Relationship Between the Extent Cooperating Teachers Utilized the Problem-Solving Approach To Teaching and the Extent Student Teachers Utilized the Problem-Solving Approach To Teaching (n = 12)

<table>
<thead>
<tr>
<th>Extent of Use of the Problem-Solving Approach To Teaching by Cooperating Teachers</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>.66</td>
<td>.01</td>
</tr>
</tbody>
</table>

Figure 4. Relationship Between the Extent Cooperating Teachers Utilized the Problem-Solving Approach To Teaching and the Extent Student Teachers Utilized the Problem-Solving Approach To Teaching (n = 12)

Teaching Methods Utilized by Student Teachers, While Using the Problem-Solving Approach To Teaching

To describe the teaching methods that student teachers utilized while using the problem-solving approach to teaching, during the student teaching practicum, three separate class periods of their "classroom" teaching were analyzed. In addition, the three separate class periods of "classroom" teaching were summated to obtain total scores for the three observations.
First Observation

During the first observation, an average of 11 percent of the student teachers' instructional time was spent utilizing the teaching method of "lecture/discussion" and six percent utilizing the teaching method of "supervised study" while using the problem-solving approach to teaching (Table 17). Student teachers spent no time utilizing the remaining teaching methods while using the problem-solving approach to teaching. Furthermore, student teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Table 17

Percentage of Instructional Time of the Teaching Methods Utilized by Student Teachers While Using the Problem-Solving Approach To Teaching During the First Observation (n = 15)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>11.2</td>
<td>17.8</td>
<td>.0 - 54.7</td>
</tr>
<tr>
<td>Demonstration</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Experiment</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>5.5</td>
<td>12.5</td>
<td>.0 - 38.1</td>
</tr>
<tr>
<td>Role Play</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Other</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
</tbody>
</table>
Second Observation

During the second observation, an average of 15 percent of the student teachers' instructional time was spent utilizing the teaching method of "lecture/discussion" and eight percent utilizing the teaching method of "supervised study" while using the problem-solving approach to teaching (Table 18). Student teachers spent no time utilizing the remaining teaching methods while using the problem-solving approach to teaching. Furthermore, student teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Table 18

Percentage of Instructional Time of the Teaching Methods Utilized by Student Teachers While Using the Problem-Solving Approach To Teaching During the Second Observation (n = 15)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>14.7</td>
<td>22.6</td>
<td>.0 - 65.8</td>
</tr>
<tr>
<td>Demonstration</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Experiment</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>8.4</td>
<td>18.2</td>
<td>.0 - 58.8</td>
</tr>
<tr>
<td>Role Play</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Other</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
</tbody>
</table>
Third Observation

During the third observation, an average of nine percent of the student teachers' instructional time was spent utilizing the teaching method of "lecture/discussion" and five percent utilizing the teaching method of "supervised study" while using the problem-solving approach to teaching (Table 19). Student teachers spent no time utilizing the remaining teaching methods while using the problem-solving approach to teaching. Furthermore, student teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Table 19
Percentage of Instructional Time of the Teaching Methods Utilized by Student Teachers While Using the Problem-Solving Approach To Teaching During the Third Observation (n = 14)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>8.6</td>
<td>19.6</td>
<td>0 - 66.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0.0</td>
</tr>
<tr>
<td>Experiment</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0.0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>5.1</td>
<td>10.6</td>
<td>0 - 34.0</td>
</tr>
<tr>
<td>Role Play</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0.0</td>
</tr>
<tr>
<td>Other</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0.0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.0</td>
<td>.0</td>
<td>0 - 0.0</td>
</tr>
</tbody>
</table>
Total of the Three Observations

Total scores of the three observations indicated that an average of 12 percent of the student teachers' instructional time was spent utilizing the teaching method of "lecture/discussion" and five percent utilizing the teaching method of "supervised study" while using the problem-solving approach to teaching (Table 20). Student teachers spent no time utilizing the teaching methods of "demonstration," "experiment," and "role play" while using the problem-solving approach to teaching. Furthermore, student teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Table 20
Total of the Three Observations for the Percentage of Instructional Time of the Teaching Methods Utilized by Student Teachers While Using the Problem-Solving Approach To Teaching (n = 15)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>11.6</td>
<td>13.7</td>
<td>.0 - 48.4</td>
</tr>
<tr>
<td>Demonstration</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Experiment</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>6.0</td>
<td>8.3</td>
<td>.0 - 26.6</td>
</tr>
<tr>
<td>Role Play</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Other</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
</tbody>
</table>
Teaching Methods Utilized by Student Teachers, While Not Using the Problem-Solving Approach To Teaching

To describe the teaching methods that student teachers utilized while not using the problem-solving approach to teaching, during the student teaching practicum, three separate class periods of their "classroom" teaching were analyzed. In addition, the three separate class periods of "classroom" teaching were summated to obtain total scores for the three observations.

First Observation

During the first observation, student teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 67.9) (Table 21). Student teachers spent the least amount of instructional time utilizing the "role play" teaching method (mean = .8). In addition, student teachers spent no instructional time utilizing the "demonstration" teaching method. Furthermore, student teachers spent two percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.
Table 21

Percentage of Instructional Time of the Teaching Methods Utilized by Student Teachers While Not Using the Problem-Solving Approach To Teaching During the First Observation (n = 15)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>67.9</td>
<td>32.3</td>
<td>12.5 - 100.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Experiment</td>
<td>1.8</td>
<td>5.3</td>
<td>.0 - 20.0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>3.9</td>
<td>9.3</td>
<td>.0 - 33.3</td>
</tr>
<tr>
<td>Role Play</td>
<td>.8</td>
<td>3.1</td>
<td>.0 - 12.0</td>
</tr>
<tr>
<td>Other(^a)</td>
<td>7.4</td>
<td>13.3</td>
<td>.0 - 34.0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>1.5</td>
<td>2.4</td>
<td>.0 - 6.7</td>
</tr>
</tbody>
</table>

\(^a\) Quiz, Game/Contest, Reciting FFA Creed

Second Observation

During the second observation, student teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 47.3) (Table 22). Student teachers spent the least amount of instructional time utilizing the "experiment" teaching method (mean = .2). In addition, student teachers utilized all four of the remaining teaching methods during the second observation. Furthermore,
student teachers spent four percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Table 22

Percentage of Instructional of the Teaching Methods Utilized by Student Teachers While Not Using the Problem-Solving Approach To Teaching During the Second Observation (n = 15)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>47.3</td>
<td>28.8</td>
<td>.0 - 100.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>10.3</td>
<td>27.2</td>
<td>.0 - 78.9</td>
</tr>
<tr>
<td>Experiment</td>
<td>.2</td>
<td>.6</td>
<td>.0 - 2.2</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>10.7</td>
<td>16.1</td>
<td>.0 - 40.9</td>
</tr>
<tr>
<td>Role Play</td>
<td>.9</td>
<td>3.4</td>
<td>.0 - 13.3</td>
</tr>
<tr>
<td>Other*</td>
<td>3.3</td>
<td>5.5</td>
<td>.0 - 15.8</td>
</tr>
<tr>
<td>Idle Time</td>
<td>4.3</td>
<td>9.0</td>
<td>.0 - 35.7</td>
</tr>
</tbody>
</table>

* Quiz, Game/Contest, Reciting FFA Creed

Third Observation

During the third observation, student teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 64.6) (Table 23).
Student teachers spent the least amount of instructional time utilizing the "experiment" teaching method (mean = 2.2). In addition, student teachers spent no instructional time utilizing the "demonstration" teaching method. Furthermore, student teachers spent one percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Table 23

Percentage of Instructional Time of the Teaching Methods Utilized by Student Teachers While Not Using the Problem-Solving Approach To Teaching During the Third Observation (n = 14)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>64.6</td>
<td>35.7</td>
<td>.0 - 100.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Experiment</td>
<td>2.2</td>
<td>5.7</td>
<td>.0 - 17.8</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>10.6</td>
<td>17.8</td>
<td>.0 - 60.7</td>
</tr>
<tr>
<td>Role Play</td>
<td>4.2</td>
<td>15.8</td>
<td>.0 - 59.1</td>
</tr>
<tr>
<td>Othera</td>
<td>3.5</td>
<td>8.9</td>
<td>.0 - 25.7</td>
</tr>
<tr>
<td>Idle Time</td>
<td>1.2</td>
<td>2.3</td>
<td>.0 - 7.2</td>
</tr>
</tbody>
</table>

*a Quiz, Game/Contest, Reciting FFA Creed*
Total of the Three Observations

Total scores, for the three observations, indicated that student teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 60.8) (Table 24). Student teachers spent the least amount of instructional time utilizing the "experiment" teaching method (mean = 1.3). In addition, student teachers

Table 24
Total of the Three Observations for the Percentage of Instructional Time of the Teaching Methods Utilized by Student Teachers While Not Using the Problem-Solving Approach To Teaching (n = 15)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>60.8</td>
<td>21.5</td>
<td>14.8 - 100.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>2.6</td>
<td>7.1</td>
<td>.0 - 24.4</td>
</tr>
<tr>
<td>Experiment</td>
<td>1.3</td>
<td>2.4</td>
<td>.0 - 6.9</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>8.3</td>
<td>6.3</td>
<td>.0 - 19.8</td>
</tr>
<tr>
<td>Role Play</td>
<td>1.8</td>
<td>5.3</td>
<td>.0 - 19.5</td>
</tr>
<tr>
<td>Other(^a)</td>
<td>5.0</td>
<td>6.8</td>
<td>.0 - 20.6</td>
</tr>
<tr>
<td>Idle Time</td>
<td>2.5</td>
<td>3.7</td>
<td>.0 - 14.8</td>
</tr>
</tbody>
</table>

\(^a\) Quiz, Game/Contest, Reciting FFA Creed
utilized all four of the remaining teaching methods during the three observations. Furthermore, student teachers spent three percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Teaching Methods Utilized by Cooperating Teachers, While Using the Problem-Solving Approach To Teaching

To describe the teaching methods that cooperating teachers utilized while using the problem-solving approach to teaching, during the student teaching practicum, three separate class periods of their "classroom" teaching were analyzed. In addition, the three separate class periods of "classroom" teaching were summated to obtain total scores for the three observations.

First Observation

During the first observation, an average of 19 percent of the cooperating teachers' instructional time was spent utilizing the "lecture/discussion," three percent "supervised study," and two percent each the "demonstration" and "other" teaching methods while using the problem-solving approach to teaching (Table 25). Cooperating teachers spent no time utilizing the teaching methods of "experiment" and "role play" while using the problem-solving approach to teaching. Furthermore, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching.
Table 25

Percentage of Instructional Time of the Teaching Methods Utilized by Cooperating Teachers While Using the Problem-Solving Approach To Teaching During the First Observation (n = 10)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>18.6</td>
<td>29.4</td>
<td>0 - 75.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>1.5</td>
<td>4.7</td>
<td>0 - 14.7</td>
</tr>
<tr>
<td>Experiment</td>
<td>0.0</td>
<td>0.0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>2.6</td>
<td>6.3</td>
<td>0 - 19.4</td>
</tr>
<tr>
<td>Role Play</td>
<td>0.0</td>
<td>0.0</td>
<td>0 - 0</td>
</tr>
<tr>
<td>Othera</td>
<td>1.5</td>
<td>4.7</td>
<td>0 - 15.0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>0.0</td>
<td>0.0</td>
<td>0 - 0</td>
</tr>
</tbody>
</table>

a Game/Contest

Second Observation

During the second observation, an average of nine percent of the cooperating teachers' instructional time was spent utilizing the "lecture/discussion," seven percent "supervised study," two percent "demonstration," and one percent "experiment" teaching methods while using the problem-solving approach to teaching (Table 26). Cooperating teachers spent no time utilizing the teaching methods of "role play" and "other" while using the problem-solving approach to teaching.
Furthermore, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Table 26

Percentage of Instructional Time of the Teaching Methods Utilized by Cooperating Teachers While Using the Problem-Solving Approach To Teaching During the Second Observation (n = 10)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>9.0</td>
<td>16.0</td>
<td>0.0 - 40.9</td>
</tr>
<tr>
<td>Demonstration</td>
<td>1.9</td>
<td>5.9</td>
<td>0.0 - 18.6</td>
</tr>
<tr>
<td>Experiment</td>
<td>1.4</td>
<td>4.4</td>
<td>0.0 - 14.0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>7.0</td>
<td>17.2</td>
<td>0.0 - 54.5</td>
</tr>
<tr>
<td>Role Play</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0 - 0.0</td>
</tr>
<tr>
<td>Other</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0 - 0.0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0 - 0.0</td>
</tr>
</tbody>
</table>

Third Observation

During the third observation, an average of six percent of the cooperating teachers' instructional time was spent utilizing the "lecture/discussion," two percent "supervised study," and one percent "role play" teaching methods while using the problem-solving approach to teaching (Table 27). Cooperating teachers spent no time utilizing the teaching methods of "demonstration," "experiment," and "other" while
using the problem-solving approach to teaching. Furthermore, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Table 27
Percentage of Instructional Time of the Teaching Methods Utilized by Cooperating Teachers While Using the Problem-Solving Approach To Teaching During the Third Observation (n = 9)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>6.0</td>
<td>13.3</td>
<td>.0 - 39.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Experiment</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>2.4</td>
<td>7.1</td>
<td>.0 - 21.4</td>
</tr>
<tr>
<td>Role Play</td>
<td>1.1</td>
<td>3.3</td>
<td>.0 - 9.8</td>
</tr>
<tr>
<td>Other</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
</tbody>
</table>

Total of the Three Observations

Total scores of the three observations indicated that an average of 12 percent of the cooperating teachers' instructional time was spent utilizing the "lecture/discussion," four percent "supervised study," and one percent "demonstration" teaching methods while using the problem-solving approach to teaching (Table 28). In addition,
cooperating teachers utilized the "experiment," "role play," and "other" teaching methods less than one percent of the time. Furthermore, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Table 28
Total of the Three Observations for the Percentage of Instructional Time of the Teaching Methods Utilized by Cooperating Teachers While Using the Problem-Solving Approach To Teaching (n = 10)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>11.8</td>
<td>17.1</td>
<td>.0 - 50.4</td>
</tr>
<tr>
<td>Demonstration</td>
<td>1.1</td>
<td>2.4</td>
<td>.0 - 6.4</td>
</tr>
<tr>
<td>Experiment</td>
<td>.5</td>
<td>1.5</td>
<td>.0 - 4.8</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>4.0</td>
<td>8.2</td>
<td>.0 - 25.6</td>
</tr>
<tr>
<td>Role Play</td>
<td>.3</td>
<td>1.0</td>
<td>.0 - 3.3</td>
</tr>
<tr>
<td>Other</td>
<td>.5</td>
<td>1.5</td>
<td>.0 - 4.8</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
</tbody>
</table>

*a Game/Contest

Teaching Methods Utilized by Cooperating Teachers, While Not Using the Problem-Solving Approach To Teaching

To describe the teaching methods that cooperating teachers utilized while not using the problem-solving approach
to teaching, during the student teaching practicum, three separate class periods of their "classroom" teaching were analyzed. In addition, the three separate class periods of "classroom" teaching were summated to obtain total scores for the three observations.

First Observation

During the first observation, cooperating teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 62.6) (Table 29). Cooperating teachers spent the least amount of instructional

Table 29

Percentage of Instructional Time of the Teaching Methods Utilized by Cooperating Teachers While Not Using the Problem-Solving Approach To Teaching During the First Observation (n = 10)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>62.6</td>
<td>30.1</td>
<td>5.6 - 100.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>1.8</td>
<td>5.6</td>
<td>.0 - 17.6</td>
</tr>
<tr>
<td>Experiment</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>10.5</td>
<td>17.5</td>
<td>.0 - 50.0</td>
</tr>
<tr>
<td>Role Play</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Other</td>
<td>.0</td>
<td>.0</td>
<td>.0 - .0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>1.0</td>
<td>2.3</td>
<td>.0 - 7.1</td>
</tr>
</tbody>
</table>
time utilizing the "demonstration" teaching method (mean = 1.8). In addition, cooperating teachers spent no instructional time utilizing the "experiment," "role play," and "other" teaching methods. Furthermore, cooperating teachers spent one percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Second Observation

During the second observation, cooperating teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 64.5) (Table 30). Cooperating teachers spent the least amount of instructional time utilizing the "demonstration" teaching method (mean = .7). In addition, cooperating teachers spent no instructional time utilizing "other" teaching methods. Furthermore, cooperating teachers exhibited no "idle time" while not using the problem-solving approach to teaching.
Table 30

**Percentage of Instructional Time of the Teaching Methods Utilized by Cooperating Teachers While Not Using the Problem-Solving Approach To Teaching During the Second Observation (n = 10)**

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>64.5</td>
<td>34.5</td>
<td>4.5 - 100.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>0.7</td>
<td>2.2</td>
<td>0.0 - 6.9</td>
</tr>
<tr>
<td>Experiment</td>
<td>2.1</td>
<td>6.6</td>
<td>0.0 - 20.8</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>3.3</td>
<td>6.1</td>
<td>0.0 - 16.2</td>
</tr>
<tr>
<td>Role Play</td>
<td>10.1</td>
<td>26.2</td>
<td>0.0 - 82.8</td>
</tr>
<tr>
<td>Other</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0 - 0.0</td>
</tr>
<tr>
<td>Idle Time</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0 - 0.0</td>
</tr>
</tbody>
</table>

**Third Observation**

During the third observation, cooperating teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 55.3) (Table 31). Cooperating teachers spent the least amount of instructional time utilizing the "other" teaching method (mean = 3.9), which included evaluating students with quizzes and using games/contests as teaching tools. In addition, cooperating teachers utilized all four of the remaining teaching methods. Furthermore, cooperating teachers exhibited one percent "idle
time" while not using the problem-solving approach to teaching.

Table 31
Percentage of Instructional Time of the Teaching Methods Utilized by Cooperating Teachers While Not Using the Problem-Solving Approach To Teaching During the Third Observation (n = 9)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>55.3</td>
<td>28.7</td>
<td>.0 - 78.0</td>
</tr>
<tr>
<td>Demonstration</td>
<td>14.6</td>
<td>32.7</td>
<td>.0 - 100.0</td>
</tr>
<tr>
<td>Experiment</td>
<td>4.0</td>
<td>11.9</td>
<td>.0 - 35.7</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>8.4</td>
<td>7.8</td>
<td>.0 - 22.4</td>
</tr>
<tr>
<td>Role Play</td>
<td>4.1</td>
<td>12.2</td>
<td>.0 - 36.6</td>
</tr>
<tr>
<td>Other(^a)</td>
<td>3.9</td>
<td>7.7</td>
<td>.0 - 18.8</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.5</td>
<td>1.4</td>
<td>.0 - 4.1</td>
</tr>
</tbody>
</table>

\(^a\) Quiz, Game/Contest

Total of the Three Observations

Total scores, for the three observations, indicated that cooperating teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 61.5) (Table 32). Cooperating
teachers spent the least amount of instructional time utilizing the "other" teaching method (mean = 1.2). In addition, cooperating teachers utilized all four of the remaining teaching methods during the three observations. Furthermore, cooperating teachers spent less than one percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Table 32
Total of the Three Observations for the Percentage of Instructional Time of the Teaching Methods Utilized by Cooperating Teachers While Not Using the Problem-Solving Approach To Teaching (n = 10)

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Mean</th>
<th>S.D.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/Discussion</td>
<td>61.5</td>
<td>23.6</td>
<td>7.4 - 89.4</td>
</tr>
<tr>
<td>Demonstration</td>
<td>4.7</td>
<td>8.6</td>
<td>.0 - 27.5</td>
</tr>
<tr>
<td>Experiment</td>
<td>2.1</td>
<td>4.8</td>
<td>.0 - 14.3</td>
</tr>
<tr>
<td>Supervised Study</td>
<td>7.7</td>
<td>7.4</td>
<td>.0 - 25.5</td>
</tr>
<tr>
<td>Role Play</td>
<td>4.1</td>
<td>7.7</td>
<td>.0 - 22.6</td>
</tr>
<tr>
<td>Other(^a)</td>
<td>1.2</td>
<td>2.6</td>
<td>.0 - 6.5</td>
</tr>
<tr>
<td>Idle Time</td>
<td>.5</td>
<td>1.1</td>
<td>.0 - 3.6</td>
</tr>
</tbody>
</table>

\(^a\) Quiz, Game/Contest
CHAPTER V
SUMMARY, CONCLUSIONS AND IMPLICATIONS, AND RECOMMENDATIONS

Purpose of the Study

The purpose of the study was to test the hypothesized relationships between student teachers' preferred learning styles and problem-solving ability and the extent of use of the problem-solving approach to teaching during the student teaching practicum. The study further sought to test the hypothesized relationship between the extent cooperating teachers utilized the problem-solving approach to teaching and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. In addition, the study sought to describe the teaching methods utilized, by student and cooperating teachers, while using and not using the problem-solving approach to teaching during the student teaching practicum. To guide the study the following research hypotheses and objectives were developed:

Research Hypotheses of the Study

1. The more field-independent the student teachers' learning style, the greater their problem-solving ability.
2. The more field-independent the student teachers' learning style, the greater their extent of use of the problem-solving approach to teaching during the student teaching practicum.

3. The greater the extent cooperating teachers utilize the problem-solving approach to teaching, the greater the extent student teachers utilize the problem-solving approach to teaching during the student teaching practicum.

Objectives of the Study

1. To describe the teaching methods utilized by student teachers, while using the problem-solving approach to teaching.

2. To describe the teaching methods utilized by student teachers, while not using the problem-solving approach to teaching.

3. To describe the teaching methods utilized by cooperating teachers, while using the problem-solving approach to teaching.

4. To describe the teaching methods utilized by cooperating teachers, while not using the problem-solving approach to teaching.

Limitations of the Study

The study was descriptive and relational in nature. A relational study cannot establish cause-and-effect relationships among variables (Borg & Gall, 1989). Therefore,
the study sought only to describe characteristics and test hypothesized relationships among characteristics.

The study was further limited by the method of subject selection. Accessible samples of agriculture student teachers and cooperating teachers were selected to participate in the study. The agriculture student teachers and cooperating teachers were restricted to those who were engaged in the student teacher practicum at The Ohio State University during Autumn Quarter, 1992. Therefore, results of the study were generalizable only to the accessible student teacher and cooperating teacher samples.

**Design of the Study**

A descriptive-correlation research design was utilized to test the research hypotheses and to accomplish the objectives of the study. Descriptive research techniques were used to portray the incidence, distribution, and characteristics of the subjects' learning style, problem-solving ability, and the extent that subjects utilized the problem-solving approach to teaching.

Furthermore, descriptive research techniques were used to describe the teaching methods utilized while subjects were using the problem-solving approach to teaching, and the teaching methods utilized while subjects were not using the problem-solving approach to teaching. Correlational procedures were utilized to test the hypothesized relationships between subjects' learning style and problem-
solving ability and the extent subjects utilized the problem-solving approach to teaching.

Population and Sample

Student Teachers

The target population for the study was preservice teachers majoring in agricultural education at The Ohio State University. The accessible sample was preservice agriculture teachers enrolled in Agricultural Education 580, "Student Teaching in Agriculture," at The Ohio State University during the Autumn Quarter, 1992. The accessible sample consisted of 11 male and six female (n = 17) student teachers. The 17 student teachers were preparing for certification to teach production agriculture.

The student teacher responding sample consisted of 10 males and five females (n = 15). One student teacher was deleted from the study because his cooperating teacher had not completed the cooperating teacher seminar prior to Autumn Quarter, 1992. In addition, one student teacher declined to complete the requested videotapes; therefore the student teacher was not included in the study.

Cooperating Teachers

The target population for the study was secondary agriculture teachers in Ohio approved by the Department of Agricultural Education at The Ohio State University to serve as cooperating teachers. The cooperating teacher accessible sample consisted of 13 male (n = 13) secondary production
agriculture teachers in Ohio who were approved by the faculty in the Department of Agricultural Education at The Ohio State University to serve as cooperating teachers for the student teaching practicum during the Autumn Quarter, 1992. Four of the cooperating teachers were assigned the responsibility of supervising two student teachers each.

The cooperating teacher responding sample consisted of 10 males (n = 10). One cooperating teacher was deleted from the study because he had not completed the cooperating teacher seminar prior to Autumn Quarter, 1992. In addition, two cooperating teachers declined to complete the requested videotapes; therefore the two cooperating teachers were not included in the study.

Instrumentation

Three instruments were utilized to collect the data necessary to test the research hypotheses and accomplish the objectives of the study. Two of the instruments were considered standardized instruments and the third instrument was developed by Garton and Cano (1992) (Appendix B).

Group Embedded Figures Test

The Group Embedded Figures Test (GEFT) (Oltman, Raskin, Witkin, 1971) was used to determine the preferred learning style of the student teachers as either field-dependent or field-independent. The Group Embedded Figures Test (GEFT) is considered a standardized instrument and has been used
extensively in educational research (Witkin, Oltman, Raskin, & Karp, 1971).

Subjects scoring greater than the national norm (11.4) (Witkin, Oltman, Raskin, & Karp, 1971) were considered to be leaning toward the field-independent learning style while subjects scoring less than the national norm were considered to be leaning toward the field-dependent learning style. Validity and reliability of the GEFT was established by the developers of the test (Witkin, Oltman, Raskin, & Karp, 1971).

Cornell Critical Thinking Test, Level Z

The Cornell Critical Thinking Test, Level Z (Ennis & Millman, 1985), was used to determine the problem-solving ability of the student teachers and is considered a standardized instrument. One total score was calculated for the test by taking the number of correct responses minus one-half the number of incorrect responses (Ennis, Millman, & Tomko, 1985). Validity and reliability of the Cornell Critical Thinking Test, Level Z, was assessed by the developers of the test (Ennis, Millman, Tomko, 1985).

Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory

The Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory (Appendix B) was used to describe the extent that student teachers and cooperating teachers utilized the problem-solving approach to teaching. The Extent Of Use Of The Problem-
Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory was developed by Garton and Cano (1992) and consisted of 10 procedures that represented a teacher's extent of use of the problem-solving approach to teaching. In addition, the instrument identified teaching methods utilized in the teaching/learning process, either while using the problem-solving approach to teaching, or while not using the problem-solving approach to teaching.

The instrument was assessed for validity by a panel of experts, consisting of teacher educators in agriculture, who were considered to be knowledgeable on the problem-solving approach to teaching (Appendix C). Intra-rater reliability of the instrument was established, prior to the analysis of data, by assessing 10 microteaching videotapes from Agricultural Education 530 "Methods of Teaching Agriculture." To add further support to the intra-rater reliability, 10 randomly selected teachings from the student teachers' and cooperating teachers' actual data videotapes were reanalyzed.

Data Collection

The Group Embedded Figures Test (GEFT) was administered to student teachers during the quarter of enrollment in Agricultural Education 530, "Methods of Teaching Agriculture." The Cornell Critical Thinking Test, Level Z, was administered to student teachers during the second student teacher seminar that was held on The Ohio State University campus during the student teaching practicum. Procedures for administration of
the tests as outlined in the Group Embedded Figures Test Manual (Witkin, Oltman, Raskin, & Karp, 1971) and the Cornell Critical Thinking Tests Level X & Level Z Manual (Third Edition) (Ennis, Millman, & Tomko, 1985) were followed.

To determine the extent that the problem-solving approach to teaching was utilized during the student teaching practicum, student teachers and cooperating teachers were asked to videotape three separate class periods of their "classroom" teaching. Specific directions were provided on the procedures to follow in videotaping the "classroom" teaching (Appendix F and Appendix G).

At the conclusion of the student teaching practicum, videotapes from the student teachers and cooperating teachers were analyzed by the researcher. The subjects' three class periods of "classroom" teaching were analyzed separately using the Extent Of Use Of The Problem-Solving Approach To Teaching and The Utilization Of Teaching Methods Inventory (Garton & Cano, 1992).

Data Analysis

All data were analyzed utilizing SPSS/PC+. Descriptive research techniques were used to portray the incidence, distribution, and characteristics of the subjects' learning style, problem-solving ability, and the extent that subjects utilized the problem-solving approach to teaching. Furthermore, descriptive research techniques were used to describe the teaching methods utilized while subjects were
using the problem-solving approach to teaching, and the teaching methods utilized while subjects were not using the problem-solving approach to teaching.

Correlational procedures were utilized to test the hypothesized relationships between subjects' learning style and problem-solving ability and the extent subjects utilized the problem-solving approach to teaching. The magnitude of relationships reported were interpreted using Davis' (1971) descriptors. The alpha level was established a priori at .05.

**Summary of Findings**

**Learning Styles of Student Teachers**

Thirty three percent (5) of the student teachers had a preference toward a field-dependent learning style and 67 percent (10) had a preference toward a field-independent learning style. A gender analysis revealed that 60 percent (3) of the females preferred a field-dependent learning style and 40 percent (2) preferred a field-independent learning style. Twenty percent (2) of the males preferred a field-dependent learning and 80 percent (8) preferred a field-independent learning style. Student teachers' scores on the Group Embedded Figures Test ranged from a minimum of seven to a maximum of 17, with a mean score of 13.2, and a standard deviation of 3.5.

**Problem-Solving Ability of Student Teachers**

Student teachers' problem-solving ability, as assessed by the Cornell Critical Thinking Test, Level Z, scores ranged
from zero to 29.5. The student teachers' mean score on the Cornell Critical Thinking Test, Level Z was 16.1, with a standard deviation of 6.9. Forty percent (6) of the student teachers' scores were in the 15.0 to 19.9 range. Furthermore, 73 percent (11) of the student teachers scored below 20.0 on the Cornell Critical Thinking Test, Level Z.

Research Hypothesis One

A Pearson product-moment correlation coefficient was calculated between the preferred learning style of student teachers and their problem-solving ability. A low negative, non-significant correlation (r = -.25, p > .05) was found between student teachers preferred learning style and their problem-solving ability. Therefore, failing to reject the null hypothesis; that, in the population, the relationship between student teachers' preferred learning style and their problem-solving ability was equal to zero.

Extent of Use of the Problem-Solving Approach To Teaching by Student Teachers

First Observation

During the first observation, an average of 17 percent of the student teachers' instructional time was spent utilizing the problem-solving approach to teaching. Student teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 71 percent.

With regard to the 10 problem-solving approach to teaching procedures, student teachers spent the greatest
amount of time using the problem-solving approach to teaching procedure "guiding students in seeking data and information needed to analyze potential solutions to the problem" (mean = 7.6). Student teachers spent no time utilizing three of the nine remaining problem-solving approach to teaching procedures.

**Second Observation**

During the second observation, an average of 23 percent of the student teachers' instructional time was spent utilizing the problem-solving approach to teaching. Student teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 100 percent.

With regard to the 10 problem-solving approach to teaching procedures, student teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "guiding students in seeking data and information needed to analyze potential solutions to the problem" (mean = 10.9). Student teachers spent no time utilizing four of the nine remaining problem-solving approach to teaching procedures.

**Third Observation**

During the third observation, an average of 14 percent of the student teachers' instructional time was spent utilizing the problem-solving approach to teaching. Student teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 100 percent.
Regarding the 10 problem-solving approach to teaching procedures, student teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "assisting students in analyzing the data and information to determine a solution to the problem" (mean = 4.8). Student teachers spent no time utilizing two of the nine remaining problem-solving approach to teaching procedures.

**Total of the Three Observations**

Total scores of the three observations, for the student teachers' "classroom" teaching, indicated that an average of 18 percent of the student teachers' instructional time was spent utilizing the problem-solving approach to teaching. Student teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 75 percent.

Regarding the 10 problem-solving approach to teaching procedures, student teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "guiding students in seeking data and information needed to analyze potential solutions to the problem" (mean = 7.4). Student teachers spent less than one percent of their instruction time utilizing the problem-solving approach to teaching procedures "drawing possible solutions to the problem from the student," "leading students in discovering the factors needed to be considered in exploring a possible solution to the problem," "leading student in arriving at a tentative conclusion and/or recommendations to the problem,"
and "leading students in evaluating the results of the solution to the problem." Furthermore, student teachers spent no time utilizing the problem-solving approach to teaching procedures "organizing instruction around solvable problem statements" and "guiding students in applying the solutions and/or recommendations to the problem."

**Research Hypothesis Two**

A Person product-moment correlation coefficient was calculated between the preferred learning style of student teachers and the student teachers' total score, for the three "classroom" observations, on the problem-solving approach to teaching. A substantial negative, non-significant correlation ($r = -.66, p > .05$) was found between student teachers' preferred learning style and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. Therefore, failing to reject the null hypothesis; that, in the population, the relationship between student teachers' preferred learning style and the extent they utilize the problem-solving approach to teaching during the student teaching practicum was equal to zero.

**Extent of Use of the Problem-Solving Approach To Teaching by Cooperating Teachers**

**First Observation**

During the first observation, an average of 24 percent of the cooperating teachers' instructional time was spent utilizing the problem-solving approach to teaching.
Cooperating teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 95 percent.

Regarding the 10 problem-solving approach to teaching procedures, cooperating teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "gaining and maintaining the interest of the students in learning the subject matter" (mean = 14.7). Cooperating teachers spent no time utilizing six of the remaining nine problem-solving approach to teaching procedures.

Second Observation

During the second observation, an average of 19 percent of the cooperating teachers' instructional time was spent utilizing the problem-solving approach to teaching. Cooperating teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 96 percent.

Regarding the 10 problem-solving approach to teaching procedures, cooperating teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "gaining and maintaining the interest of the students in learning the subject matter" (mean = 7.2). Cooperating teachers spent no time utilizing four of the remaining nine problem-solving approach to teaching procedures.
Third Observation

During the third observation, an average of nine percent of the cooperating teachers' instructional time was spent utilizing the problem-solving approach to teaching. Cooperating teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 49 percent.

Regarding the 10 problem-solving approach to teaching procedures, cooperating teachers spent all of their time using the problem-solving approach to teaching procedure "gaining and maintaining the interest of the students in learning the subject matter" (mean = 9.4). Cooperating teachers spent no time utilizing the remaining nine problem-solving approach to teaching procedures during the third observation.

Total of the Three Observations

Total scores of the three observations, for the cooperating teachers' "classroom" teaching, indicated that an average of 18 percent of the cooperating teachers' instructional time was spent utilizing the problem-solving approach to teaching. Cooperating teachers' percentage of time utilizing the problem-solving approach to teaching ranged from zero to 79 percent.

Regarding the 10 problem-solving approach to teaching procedures, cooperating teachers spent the greatest amount of time using the problem-solving approach to teaching procedure "gaining and maintaining the interest of the students in
learning the subject matter" (mean = 11.0). Cooperating teachers spent less than one percent of their instruction time utilizing the problem-solving approach to teaching procedures "leading students in defining a clear statement of the problem," "leading students in discovering the factors needed to be considered in exploring a possible solution to the problem," "guiding students in applying the solutions and/or recommendations to the problem," and "leading students in evaluating the results of the solution to the problem." Furthermore, Cooperating teachers spent no time utilizing the problem-solving approach to teaching procedures "organizing instruction around solvable problem statements" and "drawing possible solutions to the problem from the students."

**Research Hypothesis Three**

A Person product-moment correlation coefficient was calculated between the cooperating teachers' total score, for the three "classroom" observations, on the problem-solving approach to teaching and the student teachers' total score, for the three "classroom" observations, on the problem-solving approach to teaching. A substantial positive, significant correlation ($r = .66, p < .05$) was found between the extent cooperating teachers and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. Therefore, the null hypothesis was rejected and the research hypothesis was accepted as being tenable; that, in the population, the relationship between the
extent cooperating teachers and the extent student teachers
utilized the problem-solving approach to teaching during the
student teaching practicum was greater than zero.

Teaching Methods Utilized by Student Teachers, While Using the
Problem-Solving Approach To Teaching

First Observation

During the first observation, an average of 11 percent of
the student teachers' instructional time was spent utilizing
the teaching method of "lecture/discussion" and six percent
utilizing the teaching method of "supervised study" while
using the problem-solving approach to teaching. Student
teachers spent no time utilizing the teaching methods of
"demonstration," "experiment," "role play," and "other" while
using the problem-solving approach to teaching. Furthermore,
student teachers exhibited no "idle time" while using the
problem-solving approach to teaching.

Second Observation

During the second observation, an average of 15 percent
of the student teachers' instructional time was spent utilizing
the teaching method of "lecture/discussion" and
eight percent utilizing the teaching method of "supervised
study" while using the problem-solving approach to teaching.
Student teachers spent no time utilizing the teaching methods
of "demonstration," "experiment," "role play," and "other"
while using the problem-solving approach to teaching.
Furthermore, student teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Third Observation

During the third observation, an average of nine percent of the student teachers' instructional time was spent utilizing the teaching method of "lecture/discussion" and five percent utilizing the teaching method of "supervised study" while using the problem-solving approach to teaching. Student teachers spent no time utilizing the teaching methods of "demonstration," "experiment," "role play," and "other" while using the problem-solving approach to teaching. Furthermore, student teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Total of the Three Observations

Total scores of the three observations indicated that an average of 12 percent of the student teachers' instructional time was spent utilizing the teaching method of "lecture/discussion" and five percent utilizing the teaching method of "supervised study" while using the problem-solving approach to teaching. Student teachers spent no time utilizing the teaching methods of "demonstration," "experiment," "role play," and "other" while using the problem-solving approach to teaching. Furthermore, student teachers exhibited no "idle time" while using the problem-solving approach to teaching.
Teaching Methods Utilized by Student Teachers, While Not Using the Problem-Solving Approach To Teaching

First Observation

During the first observation, student teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 67.9). Student teachers spent the least amount of instructional time utilizing the "role play" teaching method (mean = .8). In addition, student teachers spent no instructional time utilizing the "demonstration" teaching method. Furthermore, student teachers spent two percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Second Observation

During the second observation, student teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 47.3). Student teachers spent the least amount of instructional time utilizing the "experiment" teaching method (mean = .2). In addition, student teachers utilized all four of the remaining teaching methods during the second observation. Furthermore, student teachers spent four percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.
Third Observation

During the third observation, student teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 64.6). Student teachers spent the least amount of instructional time utilizing the "experiment" teaching method (mean = 2.2). In addition, student teachers spent no instructional time utilizing the "demonstration" teaching method. Furthermore, student teachers spent one percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Total of the Three Observations

Total scores, for the three observations, indicated that student teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 60.8). Student teachers spent the least amount of instructional time utilizing the "experiment" teaching method (mean = 1.3). In addition, student teachers utilized the "supervised study" (8.3 %), "other" (5.0 %), "demonstration" (2.6 %), and "role play" (1.8 %) methods of teaching during the three observations. Furthermore, student teachers spent three percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.
Teaching Methods Utilized by Cooperating Teachers, While Using the Problem-Solving Approach To Teaching

First Observation

During the first observation, an average of 19 percent of the cooperating teachers' instructional time was spent utilizing the "lecture/discussion," three percent "supervised study," and two percent each the "demonstration" and "other" teaching methods while using the problem-solving approach to teaching. Cooperating teachers spent no time utilizing the teaching methods of "experiment" and "role play" while using the problem-solving approach to teaching. Furthermore, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Second Observation

During the second observation, an average of nine percent of the cooperating teachers' instructional time was spent utilizing the "lecture/discussion," seven percent "supervised study," two percent "demonstration," and one percent "experiment" teaching methods while using the problem-solving approach to teaching. Cooperating teachers spent no time utilizing the teaching methods of "role play" and "other" while using the problem-solving approach to teaching. Furthermore, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching.
Third Observation

During the third observation, an average of six percent of the cooperating teachers' instructional time was spent utilizing the "lecture/discussion," two percent "supervised study," and one percent "role play" teaching methods while using the problem-solving approach to teaching. Cooperating teachers spent no time utilizing the teaching methods of "demonstration," "experiment," and "other" while using the problem-solving approach to teaching. Furthermore, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching.

Total of the Three Observations

Total scores of the three observations indicated that an average of 12 percent of the cooperating teachers' instructional time was spent utilizing the "lecture/discussion," four percent "supervised study," and one percent "demonstration" teaching methods while using the problem-solving approach to teaching. In addition, cooperating teachers utilized the "experiment," "role play," and "other" teaching methods less than one percent of the time. Furthermore, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching.
Teaching Methods Utilized by Cooperating Teachers, While Not Using the Problem-Solving Approach To Teaching

First Observation

During the first observation, cooperating teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" (mean = 62.6) and "supervised study" (mean = 10.5) teaching methods. Cooperating teachers spent the least amount of instructional time utilizing the "demonstration" teaching method (mean = 1.8).

In addition, cooperating teachers spent no instructional time utilizing the "experiment," "role play," and "other" teaching methods. Furthermore, cooperating teachers spent one percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Second Observation

During the second observation, cooperating teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" (mean = 64.5) and "role play" (mean = 10.1) teaching methods. Cooperating teachers spent the least amount of instructional time utilizing the "demonstration" teaching method (mean = .7).

In addition, cooperating teachers spent no instructional time utilizing "other" teaching method. Furthermore,
cooperating teachers exhibited no "idle time" while not using the problem-solving approach to teaching.

**Third Observation**

During the third observation, cooperating teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" (mean = 55.3) and "demonstration" (mean = 14.6) teaching methods. Cooperating teachers spent the least amount of instructional time utilizing the "other" teaching method (mean = 3.9), which included evaluating students with quizzes and using games/contests as teaching tools.

In addition, cooperating teachers utilized all four of the remaining teaching methods. Furthermore, cooperating teachers exhibited one percent "idle time" while not using the problem-solving approach to teaching.

**Total of the Three Observations**

Total scores, for the three observations, indicated that cooperating teachers spent the greatest amount of instructional time, while not using the problem-solving approach to teaching, utilizing the "lecture/discussion" teaching method (mean = 61.5). Cooperating teachers spent the least amount of instructional time utilizing the "other" teaching method (mean = 1.2).

In addition, cooperating teachers utilized the "supervised study" (7.7 %), "demonstration" (4.7 %), "role
play" (4.1 %), and "experiment" (2.1 %) methods of teaching during the three observations. Furthermore, cooperating teachers spent less than one percent of their instructional time in the category of "idle time" while not using the problem-solving approach to teaching.

Conclusions and Implications

The following conclusions and implications are based on the interpretation of data presented in the study.

Conclusion 1:

From the findings of the study it was concluded that the agriculture student teachers differed in their preferred learning styles. The student teachers mean score on the Group Embedded Figures Test was 13.2, which exceeded the national norm of 11.4 (Witkin, Oltman, Raskin, Karp, 1971). Furthermore, the student teachers' scores on the GEFT ranged from seven to 17, indicating that none of the student teachers were extremely field-dependent learners.

A majority (67 %) of the student teachers leaned toward a field-independent learning style. The data supported the findings of previous research (Witkin, Moore, Goodenough, & Cox 1977; Cano, Garton, & Raven, 1991; Cano & Garton, 1992), that found teachers specializing in the area of agriculture to lean more towards a field-independent learning style.

Implication 1:

Possessing knowledge that preservice teachers of agriculture learn differently has implications for the
agriculture teacher preparation program. Have teacher educators in agriculture remained cognizant of the diverse learning styles of preservice teachers of agriculture?

A majority of the student teachers leaned toward the field-independent learning style. Therefore, a majority of the student teachers presumably viewed the world more analytical, found it easier to accomplish tasks that encompassed several steps, and favored an "inquiry" approach to teaching. Furthermore, the student teachers probably imposed their own structure on the learning situation, enjoyed working on independent studies, and were intrinsically motivated to learn.

Although a majority of the student teachers preferred a field-independent learning style, some leaned toward the field-dependent learning style. The student teachers leaning toward a field-dependent learning style presumably viewed the world more globally, found it more difficult to accomplish tasks with many steps, and favored a "spectator approach" to learning. Furthermore, student teachers with field-dependent learning styles probably tended to adopt the organization and structure of the teacher, enjoyed working in groups, and were extrinsically motivated to learn.

Conclusion 2:

The agriculture student teachers' mean problem-solving ability score, as assessed by the Cornell Critical Thinking Test, Level Z, was 16.1, which was less than the established
norm of 19.8 for undergraduate students of similar age and educational background (Ennis, Millman, Tomko, 1985). Approximately three fourths (73.4%) of the student teachers' scores were at or below the established norm score (19.8) for undergraduate students of similar age and educational background. In addition, the problem-solving ability mean score (16.1) for the student teachers in the current study was similar to the problem-solving ability mean score of 16.9 for preservice teachers of agriculture in a previous study by McKee (1991).

**Implication 2:**

The problem-solving ability of the student teachers was less than undergraduate students of similar age and educational background. The finding implies that the student teachers possessed low problem-solving abilities. Furthermore, the low problem-solving abilities of the student teachers has potential implications for their ability to develop teaching plans and teach utilizing the problem-solving approach to teaching.

**Conclusion 3:**

A low negative, non-significant correlation was found between student teachers' preferred learning style and their problem-solving ability. Therefore, failing to reject the null hypothesis and concluding that no relationship existed between student teachers' preferred learning style, as measured by the Group Embedded Figures test, and their
problem-solving ability, as measured by the Cornell Critical Thinking Test, Level Z.

Implication 3:

No relationship was found between the student teachers' preferred learning style and their problem-solving ability. The finding implies that student teachers preferring a field-independent learning style possessed no greater problem-solving ability than the student teachers preferring a field-dependent learning style.

The finding is inconsistent with the literature and theory regarding learning styles. The student teachers preferred a more field-independent learning style. Subsequently, based on the literature (Witkin, Moore, Goodenough, & Cox, 1977), one would have assumed that there would have been a positive relationship between the student teachers' preferred learning style and problem-solving ability.

Conclusion 4:

Student teachers spent an average of 18 percent of their "classroom" instructional time, during the student teaching practicum, utilizing the problem-solving approach to teaching. Furthermore, some student teachers failed to utilize the problem-solving approach to teaching, while others utilized the problem-solving approach to teaching during three fourths of the "classroom" instructional time. The findings were consistent with the findings of previous research (McKee,
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1991). McKee (1991) concluded that the use of the problem-solving approach to teaching, by student teachers, was limited.

Implication 4:

In preparation for the student teaching practicum student teachers complete Agricultural Education 530, "Methods of Teaching Agriculture," a course that emphasizes the problem-solving approach to teaching. However, the findings imply that student teachers spent less than one fifth of their instructional time utilizing the problem-solving approach to teaching during the student teaching practicum. The data further imply that some student teachers did not utilize the problem-solving approach to teaching during the student teaching practicum.

Conclusion 5:

While using the problem-solving approach to teaching, student teachers spent the greatest amount of instructional time "guiding students in seeking data and information needed to analyze potential solutions to the problem" and in "assisting students in analyzing the data and information to determine a solution to the problem." However, no instructional time was spent "guiding students in applying the solutions and/or recommendations to the problem" or in "organizing instruction around solvable problem statements."
Implication 5:

The findings imply that while utilizing the problem-solving approach to teaching, student teachers spent the greatest amount of time guiding students in seeking data and information and analyzing the data and information. A further implication is that student teachers did not teach students how to apply solutions and/or recommendations to the problems solved.

Agricultural education is considered by many to be an applied subject. Therefore, one would assume that teachers of agriculture would be teaching students how to apply the subject content that was learned. However, in the current study, the data imply that when student teachers were found to be using the problem-solving approach to teaching, none of the "classroom" instructional time was spent teaching students how to apply the solutions and/or recommendations to the problem.

Conclusion 6:

A substantial negative, non-significant correlation was found between student teachers' preferred learning style and the extent student teachers utilized the problem-solving approach to teaching. Therefore, failing to reject the null hypothesis and concluding that no relationship existed between student teachers' preferred learning style and the extent they utilized the problem-solving approach to teaching during the student teaching practicum.
Implication 6:

The findings imply that the student teachers' learning style had no influence on the extent he/she utilized the problem-solving approach to teaching. Field-dependent learners were just as likely to utilize the problem-solving approach to teaching as field-independent learners. However, the literature (Witkin, Moore, Goodenough, & Cox, 1977) suggested that field-independent learners would be more likely to utilize the problem-solving approach to teaching.

A possible explanation is that field-dependent learners tend to learn better when the subject matter to be learned possesses organization and structure. Therefore, is it possible that field-dependent learners utilized the problem-solving approach to teaching because of its organized and structured way of teaching students the subject matter?

Conclusion 7:

Cooperating teachers spent an average of 18 percent of their "classroom" instructional time, during the student teaching practicum, utilizing the problem-solving approach to teaching. Furthermore, some cooperating teachers failed to utilized the problem-solving approach to teaching, while others utilized the problem-solving approach to teaching over three fourths of the "classroom" instructional time.

Implication 7:

The cooperating teachers were prepared during their preservice teacher preparation program to utilize the problem-
solving approach to teaching. However, the findings imply that cooperating teachers spent less than one fifth of their instructional time utilizing the problem-solving approach to teaching during the student teaching practicum. The data further imply that some cooperating teachers did not utilize the problem-solving approach to teaching during the student teaching practicum.

The findings should be of concern to teacher educators who prepare teachers of agriculture. Why have teacher educators in agriculture placed an emphasis on teaching utilizing the problem-solving approach to teaching when the evidence (Boone, 1988; Osborne & Hamzah, 1989; Boone & Newcomb, 1990; McKee, 1991) indicates that teachers of agriculture utilize the problem-solving approach to teaching on a limited basis?

Conclusion 8:

While using the problem-solving approach to teaching, cooperating teachers spent the majority of their instructional time "gaining and maintaining the interest of the students in learning the subject matter." Cooperating teachers spent only a small portion of their instructional time utilizing the remaining nine problem-solving approach to teaching procedures.

Implication 8:

The findings imply that cooperating teachers were not fully utilizing the problem-solving approach to teaching
during the student teaching practicum. Cooperating teachers were found to be creating interest in the subject matter; however, the findings imply that cooperating teachers were not teaching the subject matter based on solvable problems.

**Conclusion 9:**

A substantial positive, significant correlation was found between the extent cooperating teachers and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum. Therefore, the null hypothesis was rejected and the research hypothesis was accepted as being tenable. Based on the acceptance of the research hypothesis as being tenable, it was concluded that there was a positive relationship between the extent cooperating teachers and the extent student teachers utilized the problem-solving approach to teaching during the student teaching practicum.

**Implication 9:**

The findings imply that if cooperating teachers were utilizing the problem-solving approach to teaching, then their student teachers were more likely to utilize the problem-solving approach to teaching. Costa and Carmston (1987) stated that the modeling of teaching skills by cooperating teachers was one of the major factors contributing to the teaching behaviors of student teachers.

Furthermore, Milner (1959) suggested that the cooperating teacher's influence could be so strong as to surpass the
effect of preservice teaching methods courses. Based on the previous conclusions (Costa & Carmston, 1987; Milner, 1959) and the findings of the current study, the extent that student teachers utilized the problem-solving approach to teaching could be enhanced by the modeling of the problem-solving approach to teaching by their cooperating teachers.

**Conclusion 10:**

Student teachers utilized only two teaching methods, while using the problem-solving approach to teaching. The two teaching methods utilized were "lecture/discussion" and "supervised study." In addition, student teachers exhibited no "idle time" while using the problem-solving approach to teaching. The finding was consistent with previous research (Osborne and Hamzah, 1989) that found teachers of agriculture often taught problem solutions to students through the "lecture/discussion" and "supervised study" teaching methods.

**Implication 10:**

The findings imply that student teachers utilized only the "lecture/discussion" and "supervised study" teaching methods while using the problem-solving approach to teaching. Can the use of only two teaching methods be considered enough variability in teaching the subject content?

Research (Rosenshine & Furst, 1971) has found that effective teachers utilize a variety of teaching methods to teach the subject content. Furthermore, a variety of teaching methods have been identified for teachers of agriculture and
students to use during the problem-solving approach to teaching (Phipps & Osborne, 1988; Crunkilton & Krebs, 1982; Newcomb, McCracken, & Warmbrod, 1986).

Conclusion 11:

The variability of teaching methods increased when student teachers were not using the problem-solving approach to teaching. Student teachers utilized six teaching methods while not using the problem-solving approach to teaching. However, "lecture/discussion" was still the most utilized teaching method during student teachers' "classroom" instruction. In addition, student teachers exhibited a small amount of "idle time" while not using the problem-solving approach to teaching.

Implication 11:

The findings imply that when student teachers were not utilizing the problem-solving approach to teaching a greater variety of teaching methods were being utilized. Consequently, is it possible that more exciting activities were occurring in the classroom when student teachers were not utilizing the problem-solving approach to teaching?

However, student teachers still relied extensively on the "lecture/discussion" method of teaching when not using the problem-solving approach to teaching. Teacher educators, should be concerned with the amount of instructional time student teachers spent utilizing the "lecture/discussion" teaching method.
Conclusion 12:

Cooperating teachers utilized six teaching methods while using the problem-solving approach to teaching. The two teaching methods utilized the most were "lecture/discussion" and "supervised study." In addition, cooperating teachers exhibited no "idle time" while using the problem-solving approach to teaching. Again, the finding was consistent with previous research (Osborne and Hamzah, 1989) that found teachers of agriculture often teach problem solutions to students through the "lecture/discussion" and "supervised study" teaching methods.

Implication 12:

The findings imply that six teaching methods were utilized by cooperating teachers during the problem-solving approach to teaching. However, with the exception of "lecture/discussion" and "supervised study" the remaining teaching methods were utilized on a very limited basis. Is the primary use of two teaching methods considered enough variability to be considered an effective way to utilize the problem-solving approach to teaching?

Conclusion 13:

Cooperating teachers utilized six teaching methods while not using the problem-solving approach to teaching. However, "lecture/discussion" was still the most utilized teaching method during cooperating teachers' "classroom" instruction. In addition, cooperating teachers exhibited a small amount of
"idle time" while not using the problem-solving approach to teaching.

**Implication 13:**

The findings imply that when cooperating teachers were not utilizing the problem-solving approach to teaching a greater variety of teaching methods were being utilized. Consequently, is it possible that more exciting activities were occurring in the classroom when cooperating teachers were not utilizing the problem-solving approach to teaching?

However, cooperating teachers still relied considerably on the "lecture/discussion" method of teaching when not using the problem-solving approach to teaching. Teacher educators, should be concerned with the amount of instructional time cooperating teachers spent utilizing the "lecture/discussion" teaching method.

**Recommendations**

**Recommendation 1:**

Knowing that preservice teachers of agriculture prefer to learn differently, teacher educators must be inclusive of the diverse learning styles found in their classrooms. It is recommended that inservice education programs be conducted with teacher educators to learn more about learning styles and to learn how to be more inclusive of the diverse learning styles in their teaching.

It is further recommended that teacher educators consider the learning styles of preservice teachers when planning for
instruction and determine the most effective instructional approaches for the given learning styles. The recommendation does not suggest that teacher educators develop a different teaching plan for all learning styles. However, the learning styles of preservice teachers should be taken into consideration as the teaching plan is being developed and a variety of learning activities be included.

The preservice teacher curriculum in agricultural education should include instruction on learning styles. Preservice teachers of agriculture should have an understanding of how the learning styles of teachers and students influence and affect the teaching and learning process. Preservice teachers of agriculture should be taught how to analyze and evaluate the learning styles of students. In addition, preservice teachers should be taught how to adapt their teaching to be inclusive of the various learning styles of students.

Recommendation 2:

Preservice teachers of agriculture must be exposed to and taught how to utilize the problem-solving approach to teaching in more than just one teaching methods course. It is difficult to expect a change in the teaching and learning behaviors of preservice teachers in one 10 week quarter course. Therefore, it is recommended that teacher educators incorporate the problem-solving approach to teaching in other professional courses in the teacher preparation program.
Recommendation 3:

Additional time should be spent in the preservice teacher preparation program with regard to teaching preservice teachers how to apply solutions and/or recommendations to problems solved. Preservice teachers should have preparation in teaching the application of solutions and/or recommendations to the problem(s) under investigation.

Recommendation 4:

Cooperating teachers were selected by the Department of Agricultural Education faculty based on having met predetermined criteria. The criteria for selecting cooperating teachers included items such as the school's physical facilities, students enrolled in the agriculture program, students' supervised agriculture experience programs, FFA program, course of study, and commitment to serving as a cooperating teacher.

It is recommended that priority be given to selecting cooperating teachers who model the desired teaching behaviors expected of student teachers. If teacher educators expect student teachers to utilize the problem-solving approach to teaching, during the student teaching practicum, then cooperating teachers must be selected who utilize and model the problem-solving approach to teaching. Furthermore, cooperating teachers must understand and reinforce the expectations of student teachers with regard to the problem-
solving approach to teaching during the student teaching practicum.

Recommendation 5:

The cooperating teachers conceptualization of the problem-solving approach to teaching and that of the preservice teacher preparation program may be different. Therefore, cooperating teachers must have knowledge of the problem-solving approach to teaching as taught to preservice teachers.

Individuals selected as cooperating teachers must be required to complete an inservice education course on the use of the problem-solving approach to teaching prior to serving as a cooperating teacher. Furthermore, cooperating teachers must attend an update session each year focusing on the problem-solving approach to teaching.

Recommendation 6:

It is recommended that teacher educators incorporate a variety of teaching methods into the professional preparation courses taught during the teacher preparation program. Preservice teachers should be taught to use teaching methods that have been identified as teaching methods to use during the problem-solving approach to teaching (Newcomb, McCracken, & Warmbrod, 1986; Crunkilton & Krebs, 1982; Phipps & Osborne, 1988). Furthermore, preservice teachers should be provided with opportunities to apply a variety of teaching methods during their campus based clinical experiences.
Recommendations for Future Research

Recommendation 1:
Further research should be conducted to identify other variables influencing the low problem-solving ability of preservice teachers of agriculture. In addition, research should be conducted to determine the influence, if any, that a preservice teacher's problem-solving ability has on his/her use of the problem-solving approach to teaching.

Recommendation 2:
Research with regard to the relationship between a teacher's preferred learning style and his/her problem-solving ability should be continued with other groups of student teachers. In addition, research of this nature should be expanded to all teachers of agriculture in Ohio and duplicated with teachers of agriculture in other states.

Recommendation 3:
A longitudinal study with student teachers on the extent of their use of the problem-solving approach to teaching, during the student teaching practicum should be undertaken. The longitudinal study should begin with the current study and continue with student teachers in subsequent quarters.

Recommendation 4:
Research should be conducted to investigate what other variables, besides the cooperating teachers modeling of the problem-solving approach to teaching, influences student teachers use of the problem-solving approach to teaching.
Recommendation 5:

A longitudinal study should be conducted that follows teachers from their student teaching practicum through the first five years of teaching with regard to the extent of use of the problem-solving approach to teaching. In addition, the teaching methods utilized by the teachers should be included in the longitudinal study.

Recommendation 6:

Research should be conducted with all teachers of agriculture in Ohio, and other states, to assess the extent that the problem-solving approach to teaching is being utilized in the agricultural education profession.
APPENDIX A

AGRICULTURAL EDUCATION 530

"METHODS OF TEACHING AGRICULTURE"

COURSE SYLLABUS
AGRICULTURAL EDUCATION 530
METHODS OF TEACHING AGRICULTURE

SPRING QUARTER 1992

Instructors:
Jamie Cano, Assistant Professor
208 Agr Admin Bldg
Office Phone: 292-6321
Home Phone: 488-4305

Bryan Garton, Graduate Associate
248 Agr Admin Bldg
Office Phone: 292-6695
Home Phone: 488-6376

Required Text: Can be purchased at COP-EZ in the Ohio Union.


Course Outline

March
30 Survey of Course, assignments, grading, etc.

Reading Assignment

April
1 Philosophy of Teaching Agriculture
3 Psychology of Learning
6 Principles of Teaching and Learning
8 Principles of Teaching and Learning
10 Effective Teaching Characteristics (Rosenshine and Furst Variables)
13 Interest Approach
15 Introduction to Problem-Solving Techniques
Forked-Road Problem
p. v-vi; 1-14
p. 17-18
17 Possibilities-Factors Problem
p. 30-31
20 Steps and Key Points Problem
p. 50-51
22 Situation-To-Be-Improved Problem
p. 118-119
24 Given the Effect, Find the Cause Problem
p. 143-144
April
27 Review of the Problem-Solving Techniques
29 Teaching Methods (Lecture-Discussion)

May
1 Teaching Methods (Supervised Study) p. 15-16
4 Teaching Methods (Demonstration)
6 Review of Problem-Solving Approach
   Student Problems and Concerns
8 Levels of Cognition
11 Teaching and Questioning at Different
   Levels of Cognition
13 Learning Styles
15 Learning Styles
18 Learning Styles
20 Teaching the Culturally Diverse
22 Incorporating Learning Styles Into Teaching
25 No Class (Holiday)
27 Evaluation (Evaluating Learners)
29 Evaluation (Evaluating Learners)

June
1 Evaluation of Teaching
3 Creating Positive Learning Climates
5 Creating Positive Learning Climates
11 Final Exam: Thursday, 8:00 am - 9:48 am
Course and Microteaching Laboratory Objectives by Topic

Using the Basic Principles of Teaching and Learning and Effective Teaching Characteristics

1. Evaluate the thirteen principles of teaching and learning in simulated and clinical teaching situations.

2. Evaluate the Rosenshine and Furst effective teaching behaviors in simulated and clinical teaching situations.

Planning the Title, Terminal Performance Objective, Pupil Performance Objectives, and Situation for a Unit Plan

1. Given a unit to teach, develop a title for the unit that implies learner action or involvement that is clear to the learners.

2. Given a unit to teach, write a terminal performance objective that includes the desired performance, condition, and criterion.

3. Given a unit to teach, write pupil (clientele) performance objectives that include the desired performance, condition, and criterion.

Planning the Interest Approach and Defining the Problem(s)

1. In a laboratory teaching situation, present an interest approach that will create the "felt-need" to learn within the learners.

2. Describe on a written evaluation the principles of teaching and learning that are associated with the interest approach.

3. Evaluate orally and in writing the interest approach you conducted in the teaching laboratory. Base the evaluation on the principles of teaching and learning and effective teaching behaviors.

4. Evaluate in writing the interest approach conducted by fellow students in laboratory situations in accordance to the principles of teaching and learning and effective teaching behaviors.

5. In a laboratory teaching situation, lead learners into defining the problem to be solved through the use of an interest approach.
Types of Problems

1. Create lessons to teach utilizing the five problem-solving techniques.
2. Provided a list of pupil performance objectives, create a lesson plan utilizing the problem-solving approach.
3. Provided a problem to be solved, devise the appropriate problem-solving technique to utilize in the solution of the problem.

Mastering Teaching Methods to Use in the Problem-Solving Approach

1. Create lessons to teach utilizing at least three teaching methods.
2. Using the teaching methods learned in class, construct lesson plans to use during your extension internship, industry internship, or student teaching practicum.

Levels of Cognition

1. Evaluate the cognitive level of your teaching in laboratory situations.
2. Given a learner evaluation instrument, assess the cognitive level of the instrument.

Learning Styles / Teaching the Culturally Diverse

1. Assess your learning style and how it effects your teaching style.
2. Incorporate teaching strategies into your teaching style that will reach a culturally diverse group of learners.

Evaluating Learning

1. Given a teaching situation, decide on the appropriate method of evaluating the learners.
2. Given a lesson to teach, develop an evaluation instrument that meets the needs of the teacher and learners.

Creating Positive Learning Climates

1. Provided with different teaching situations, create positive learning climates for all learners.
2. Given a learner behavior management situation, assess the situation and decide on the appropriate action to correct the situation.
EXPLANATION OF MICROTEACHING PROCEDURES

The microteaching laboratory is designed to provide students practical application of skills necessary for teaching success. It is a practical, "hands-on" implementation of teaching. Microteaching also provides the student with the opportunity to reflect on what it takes to become an effective teacher through instructor, self, and peer evaluations. Students will be given an opportunity to correctly implement teaching strategies.

Students will teach eight (8) different microteaching lessons. Students will receive instructor feedback during a conference with Mr. Garton and/or Dr. Cano after every microteaching. Students will receive a grade for each microteaching at this feedback conference.

Expectations of Microteaching Lessons

Microteaching 1: students will teach for a maximum of 5 minutes. This lesson is to be taught with any method, technique, or approach preferred by the student.

Microteaching 2: students will develop and present an interest approach. The maximum time allowed will be 7 minutes.

Microteaching 3, 4, 5, 6, and 7: students will develop a brief interest approach, define the problem to be solved and teach using one of the five problem-solving techniques. The maximum time for each microteaching will be 15 minutes. Students must use a different problem-solving technique (five total) in each microteaching.

Microteaching 8: students are to teach as complete a lesson as possible. The maximum time will be 30 minutes. Due to the length of microteaching 8, each lab section will be split with half teaching the ninth week and half teaching the tenth week. Attendance is mandatory for all laboratory sessions. All microteachings must be on different topics.

Prior to the start of each microteaching, students will present the lab instructor with a typed copy of their lesson plan and any handouts and/or transparency masters that they intend to use in teaching the lesson. If the student fails to present the instructor with these materials, the student will not be allowed to teach their lesson and will receive a zero (0) for that lesson. Professional attire is required for all microteachings. Students are encouraged to incorporate as many pieces of audio/visual equipment into their microteaching lessons as possible.
Student/Instructor Conferences

Students are required to meet with Mr. Garton and/or Dr. Cano after every microteaching. During these weekly conferences the videotape of the student's last microteaching will be discussed and the strengths and weaknesses of the student's teaching will be examined. Students are required to view the videotape of their microteaching before the weekly conference, make a written evaluation of their teaching, and bring the tape and written evaluation to the conference. After the conference, the lab instructor will keep the tape and the student will receive his/her tape at the next lab session. VCR/TV units are available in Room 207 of the Agricultural Administration Building from 8:00 am to 4:30 pm, Monday through Friday, to view tapes.

A student/instructor conference schedule will be developed during the first week of classes. Once the student/instructor schedule is finalized, students are to meet the same day and time for the remainder of the quarter. The conferences are mandatory. Failure to attend the student/instructor conference will result in a zero (0) for the microteaching. Students will receive a copy of the instructor's evaluation sheet and a grade for each microteaching lesson during the conference.

Procedural Example

The following example is provided to illustrate the procedure followed in lab. Student A selects their topic for microteaching. The student brings to the lab session two typed copies (one for the student and one for the instructor) of their lesson plan and any needed teaching materials. The student teaches the lesson. The microteaching lesson is taped and all students complete a peer evaluation of student A's teaching. Student A takes the videotape home and views the tape before their conference with Mr. Garton and/or Dr. Cano. Student A meets with Mr. Garton and/or Dr. Cano, the strengths and weaknesses of the student's teaching are discussed, all (peer and instructor) evaluations are given to student A, and a grade is assigned for the microteaching.

Evaluation of Microteaching

The basis for evaluating the student's teaching performance will be: the extent that the microteaching objectives were met; the extent to which the principles of learning were utilized; and, the student's ability to demonstrate the first five Rosenshine and Furst (1971) teacher behaviors (clarity, variability, enthusiasm, task-oriented/businesslike behavior, and student opportunity to learn material). The major criteria for microteaching is that a student be an effective teacher.
**AGRICULTURAL EDUCATION 530**  
**METHODS OF TEACHING AGRICULTURE**  
**SPRING QUARTER, 1992**

**LABORATORY SCHEDULE**

<table>
<thead>
<tr>
<th>Lab</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
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<tbody>
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<td>1</td>
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<td>8</td>
<td>May 19</td>
<td>May 20</td>
<td>May 21</td>
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| 9   | May 26        | May 27    | May 28  
| or  |               |           |                           |
| 10  | June 2        | June 3    | June 4                    |

- Lab Orientation  
- GEFT, MBTI, & Teaching Styles  
- Microteaching 1  
- Maximum - 5 minutes  
- Problem-Solving Approach  
- Lesson Planning: Title, TPO, PPOs, & Situation  
- Microteaching 2  
- Interest Approach  
- Maximum - 7 minutes  
- Microteaching 3  
- Problem-Solving Technique  
- Maximum - 15 minutes  
- Microteaching 4  
- Problem-Solving Technique  
- Maximum - 15 minutes  
- Microteaching 5  
- Problem-Solving Technique  
- Maximum - 15 minutes  
- Microteaching 6  
- Problem-Solving Technique  
- Maximum - 15 minutes  
- Microteaching 7  
- Problem-Solving Technique  
- Maximum - 15 minutes  
- Microteaching 8  
- Teach As Complete A Lesson  
- As Time Permits  
- Maximum - 30 minutes
APPENDIX B

EXTENT OF USE OF THE PROBLEM-SOLVING APPROACH TO TEACHING

And The

UTILIZATION OF TEACHING METHODS INVENTORY
Extent Of Use Of The
Problem-Solving Approach To Teaching

And The

Utilization Of Teaching Methods
Inventory

Teacher: ________________________________

Subject Content: ________________________________

Developed by
Bryan L. Garton
and
Jamie Cano

The Ohio State University
1992
Coding Of Classroom Teaching

<table>
<thead>
<tr>
<th>Problem-Solving Approach Procedure</th>
<th>One Minute Intervals</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>One Minute Intervals</th>
<th>13</th>
<th>14</th>
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<thead>
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<th>Problem-Solving Approach Procedure</th>
<th>One Minute Intervals</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
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<thead>
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<th>Problem-Solving Approach Procedure</th>
<th>One Minute Intervals</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
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<td>Problem-Solving Approach To Teaching Procedures</td>
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<tr>
<td>1</td>
<td>Teacher was gaining and maintaining the interest of the students in learning the subject matter.</td>
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<tr>
<td>2</td>
<td>Teacher and students were organizing instruction around solvable problem statements.</td>
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<tr>
<td>3</td>
<td>Teacher was leading students in defining a clear statement of the problem.</td>
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<tr>
<td>4</td>
<td>Teacher was drawing possible solutions to the problem from the students.</td>
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<tr>
<td>5</td>
<td>Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.</td>
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<tr>
<td>6</td>
<td>Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.</td>
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<tr>
<td>7</td>
<td>Teacher was assisting students in analyzing the data and information to determine a solution to the problem.</td>
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<tr>
<td>8</td>
<td>Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.</td>
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<tr>
<td>9</td>
<td>Teacher was guiding students in applying the solutions and/or recommendations to the problem.</td>
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<tr>
<td>10</td>
<td>Teacher was leading students in evaluating the results of the solution to the problem.</td>
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<table>
<thead>
<tr>
<th>CODING NUMBER</th>
<th>Teaching Methods Utilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teacher was using a LECTURE / DISCUSSION.</td>
</tr>
<tr>
<td>2</td>
<td>Teacher was using a DEMONSTRATION.</td>
</tr>
<tr>
<td>3</td>
<td>Teacher was using an EXPERIMENT.</td>
</tr>
<tr>
<td>4</td>
<td>Teacher was using a SUPERVISED STUDY.</td>
</tr>
<tr>
<td>5</td>
<td>Teacher was using a ROLE PLAY.</td>
</tr>
<tr>
<td>6</td>
<td>Teacher was using OTHER TEACHING METHODS.</td>
</tr>
<tr>
<td>7</td>
<td>IDLE TIME, teaching/learning was not occurring.</td>
</tr>
</tbody>
</table>
## Coding Of Classroom Teaching

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</table>

*Note: The table represents a structured approach to classroom teaching, with columns for point numbers (31-60), problem-solving approach procedures, one-minute intervals, and teaching method utilized.*
### Problem-Solving Approach To Teaching Procedures

1. Teacher was gaining and maintaining the interest of the students in learning the subject matter.

2. Teacher and students were organizing instruction around solvable problem statements.

3. Teacher was leading students in defining a clear statement of the problem.

4. Teacher was drawing possible solutions to the problem from the students.

5. Teacher was leading students in discovering the factors needed to be considered in exploring a possible solution to the problem.

6. Teacher was guiding students in seeking data and information needed to analyze potential solutions to the problem.

7. Teacher was assisting students in analyzing the data and information to determine a solution to the problem.

8. Teacher was leading students in arriving at a tentative conclusion and/or recommendation to the problem.

9. Teacher was guiding students in applying the solutions and/or recommendations to the problem.

10. Teacher was leading students in evaluating the results of the solution to the problem.

### Teaching Methods Utilized

1. Teacher was using a LECTURE / DISCUSSION.

2. Teacher was using a DEMONSTRATION.

3. Teacher was using an EXPERIMENT.

4. Teacher was using a SUPERVISED STUDY.

5. Teacher was using a ROLE PLAY.

6. Teacher was using OTHER TEACHING METHODS.

7. IDLE TIME, teaching/learning was not occurring.
EXTENT OF USE OF THE PROBLEM-SOLVING APPROACH TO TEACHING
and
THE UTILIZATION OF TEACHING METHODS INVENTORY

- SUMMARY SHEET -

for

Problem-Solving Approach To Teaching Procedures

Total minutes in the observed class period: ______

<table>
<thead>
<tr>
<th>Problem-Solving Approach Procedure CODING NUMBER</th>
<th>Minutes spent utilizing the Problem-Solving Approach Procedure</th>
<th>Divide by total minutes in the class period</th>
<th>Equals the percentage of instructional time spent utilizing the Problem-Solving Approach Procedure</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td><strong>Total for the Problem-Solving Approach</strong></td>
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</tbody>
</table>
EXTENT OF USE OF THE PROBLEM-SOLVING APPROACH TO TEACHING
and
THE UTILIZATION OF TEACHING METHODS INVENTORY

- SUMMARY SHEET -

for

Teaching Methods Utilized

Total minutes in the observed class period: ____

<table>
<thead>
<tr>
<th>Teaching Methods Utilized</th>
<th>Teaching methods utilized during the use of the problem-solving approach to teaching</th>
<th>Equals % of instructional time spent utilizing the teaching method</th>
<th>Teaching methods utilized while NOT using the problem-solving approach to teaching</th>
<th>Equals % of instructional time spent utilizing the teaching method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture / Discussion</td>
<td>Minutes spent utilizing the teaching method</td>
<td>Divide by total minutes in class period</td>
<td>Minutes spent utilizing the teaching method</td>
<td>Divide by total minutes in class period</td>
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<td>Experiment</td>
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<td>Supervised Study</td>
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<td>Role Play</td>
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<tr>
<td>Other</td>
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<tr>
<td>Idle Time</td>
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</table>
APPENDIX C

VALIDITY PANEL
VALIDITY PANEL

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

Dr. Jamie Cano
208 Agricultural Administration Building
The Ohio State University
2120 Fyffe Road
Columbus, Ohio  43210

Dr. John R. Crunkilton
Department of Agricultural Education
Virginia Polytechnic Institute and
State University
Blacksburg, Virginia  24061

Dr. Lowell E. Hedges
204 Agricultural Administration Building
The Ohio State University
2120 Fyffe Road
Columbus, Ohio  43210

Dr. Bob R. Stewart
323 Townsend Hall
Department of Practical Arts and
Vocational-Technical Education
University of Missouri
Columbia, Missouri  65211

Dr. J. Robert Warmbrod
208 Agricultural Administration Building
The Ohio State University
2120 Fyffe Road
Columbus, Ohio  43210
APPENDIX D

LETTER TO STUDENT TEACHERS
August 26, 1992

Ms./Mr.
address

Dear :  

Greetings! I hope your student teaching experience is off to a good start. As you know from your experiences in Agricultural Education 530, research has shown that a person's learning style has an influence upon his/her teaching style.

You are being asked to participate in a study that will further help teacher educators in agriculture prepare future teachers and work with current teachers of agriculture. In the proposed study, your learning style and teaching style will be identified. Furthermore, the relationship between your learning style and teaching style will be assessed.

To reach the objectives of the study you are being asked to videotape a class period of your teaching on three occasions. In addition, a test to determine how you think through problems will be administered. At the same time, your cooperating teacher will be asked to videotape three class periods of his teaching. The videotapes of your teaching and the test results will be held in strict confidence and will not be used for evaluation of your student teaching experience.

Enclosed you will find some directions on the procedures and dates to videotape your teaching. The instrument to assess how you think through problems will be administered during a student teacher seminar. In the next few days you will receive a phone call to answer any questions and verify your participation in the study. Upon verification of your participation in the study, you will be mailed two VHS videotapes.
Your participation in the study is extremely important. With your assistance, valuable information will be gained that will help current and future teachers of agriculture. Your consideration of this important request is sincerely appreciated.

Sincerely,

Bryan L. Garton
Graduate Associate

Jamie Cano
Assistant Professor

Enclosure
cc: R. Kirby Barrick
August 26, 1992

Mr. [address]

Dear :

Greetings! I hope the school year is off to a good start. As you know, cooperating teachers have a tremendous impact upon the future success of student teachers. In addition, studies have shown that a person's learning style has an influence upon his/her teaching style.

You are being asked to participate in a study that will further help teacher educators in agriculture prepare future teachers and work with current teachers of agriculture. In the proposed study, your student teacher's learning and teaching style will be identified. Furthermore, the relationship between your teaching style and the teaching style of your student teacher will be assessed.

To reach the objectives of the study you are being asked to videotape a class period of your teaching on three occasions. At the same time, your student teacher will be asked to do the same. The videotapes of your teaching will be held in strict confidence.

Enclosed you will find some directions on the procedures and dates to videotape your teaching. In the next few days you will receive a phone call to answer any questions and verify your participation in the study. Upon verification of your participation in the study, you will be mailed two VHS videotapes.
Your participation in the study is extremely important. With your assistance, valuable information will be gained that will help current and future teachers of agriculture become even better teachers than they are today. Your consideration of this important request is sincerely appreciated.

Sincerely,

Bryan L. Garton
Graduate Associate

Jamie Cano
Assistant Professor

Enclosure
cc: R. Kirby Barrick
APPENDIX F

VIDEOTAPE DIRECTIONS

FOR

STUDENT TEACHERS
VIDEOTAPING DIRECTIONS

(Student Teachers)

- Please secure access to a VHS videocamera. If difficulty arises in locating a videocamera contact Bryan Garton or Jamie Cano [(614) 292-6321] to make the necessary arrangements to secure one.

- Use the two VHS videotapes that have been provided and labeled (Tape #1 and Tape #2) to do all recordings.

- Videotape one class period of your teaching during each of the following three weeks:
  1) Monday, Sept. 21 through Thursday, Sept. 24
  2) Monday, Oct. 12 through Friday, Oct. 16
  3) Monday, Nov. 2 through Friday, Nov. 6

- The three videotaped class periods of teaching should range in length of 40 minutes to one hour.

- The first and second class periods should be placed on Tape #1 and the third class period on Tape #2.

- All taped teachings should only include "classroom" teaching. Laboratory instruction is not considered "classroom" teaching.

- The videocamera should be set up and prepared prior to the beginning of the class period. The videocamera should be located in the back of the classroom to ensure as little disruption as possible.

- To videotape the class period, the videocamera should be focused on as wide an angle as possible and turned on at the beginning of class or prior to the students' arrival. The teacher being in the picture at all times is not critical. The verbal communication is the most important aspect.

- After each recording, please check the tape to ensure that the camera operated properly.

- To ensure a clear break between the first and second teachings, please fast forward the tape a few seconds after the first teaching on Tape #1.
APPENDIX G

VIDEOTAPING DIRECTIONS

FOR

COOPERATING TEACHERS
VIDEOTAPING DIRECTIONS

(Cooperating Teachers)

- Please secure access to a VHS videocamera. If difficulty arises in locating a videocamera contact Bryan Garton or Jamie Cano [(614) 292-6321] to make the necessary arrangements to secure one.

- Use the two VHS videotapes that have been provided and labeled (Tape #1 and Tape #2) to do all recordings.

- Videotape one class period of your teaching during each of the following three weeks:

  1) Tuesday, Sept. 8 through Friday, Sept. 11
  2) Monday, Sept. 14 through Friday, Sept. 18
  3) Monday, Sept. 21 through Friday, Sept. 25

- The three videotaped class periods of teaching should range in length of 40 minutes to one hour.

- The first and second class periods should be placed on Tape #1 and the third class period on Tape #2.

- All taped teachings should only include "classroom" teaching. Laboratory instruction is not considered "classroom" teaching.

- The videocamera should be set up and prepared prior to the beginning of the class period. The videocamera should be located in the back of the classroom to ensure as little disruption as possible.

- To videotape the class period, the videocamera should be focused on as wide an angle as possible and turned on at the beginning of class or prior to the students' arrival. The teacher being in the picture at all times is not critical. The verbal communication is the most important aspect.

- After each recording, please check the tape to ensure that the camera operated properly.

- To ensure a clear break between the first and second teachings, please fast forward the tape a few seconds after the first teaching on Tape #1.
APPENDIX H

SUBJECT CONTENT OF LESSONS

TAUGHT BY

STUDENT TEACHERS
Table 33

Subject Content of Lessons Taught by Student Teachers (n = 15)

<table>
<thead>
<tr>
<th>Subject Content</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plant Science:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop Production</td>
<td>4</td>
<td>9.0</td>
</tr>
<tr>
<td>Plant Growth/Development</td>
<td>3</td>
<td>6.8</td>
</tr>
<tr>
<td>Soils</td>
<td>3</td>
<td>6.8</td>
</tr>
<tr>
<td>Seed Germination</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>Weed Control</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Plant Identification</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Animal Science:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Selection/Breed Classification</td>
<td>4</td>
<td>9.0</td>
</tr>
<tr>
<td>Reproduction</td>
<td>3</td>
<td>6.8</td>
</tr>
<tr>
<td>Digestion/Nutrition</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>Animal Parts Identification</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>Dairy Goats</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Rabbits</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Milking Equipment</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Agricultural Mechanics:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc Welding</td>
<td>3</td>
<td>6.8</td>
</tr>
<tr>
<td>Concrete</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>Land Survey</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Woodworking</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Small Gas Engines</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>FFA Organization/History</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>Futures Marketing</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>Parliamentary Procedure</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>Wildlife Management</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Employment Hunting Skills</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>44</td>
<td>100.0</td>
</tr>
</tbody>
</table>
APPENDIX I

SUBJECT CONTENT OF LESSONS

TAUGHT BY

COOPERATING TEACHERS
Table 34

Subject Content of Lessons Taught by Cooperating Teachers
(n = 10)

<table>
<thead>
<tr>
<th>Subject Content</th>
<th>f</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td><strong>Plant Science:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soils</td>
<td>5</td>
<td>17.2</td>
</tr>
<tr>
<td>Plant Identification</td>
<td>3</td>
<td>10.3</td>
</tr>
<tr>
<td>Fertilizer Application</td>
<td>2</td>
<td>7.0</td>
</tr>
<tr>
<td>Crop Production</td>
<td>2</td>
<td>7.0</td>
</tr>
<tr>
<td>Plant Growth/Development</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Animal Science:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Selection/Breed Classification</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>Preparing Animals for Show</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Agricultural Mechanics:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Gas Engines</td>
<td>3</td>
<td>10.3</td>
</tr>
<tr>
<td>Electricity</td>
<td>3</td>
<td>10.3</td>
</tr>
<tr>
<td>Hand Tools</td>
<td>3</td>
<td>10.3</td>
</tr>
<tr>
<td>Parliamentary Procedure</td>
<td>2</td>
<td>7.0</td>
</tr>
<tr>
<td>Computer Equipment &amp; Operation</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>Sales Techniques</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>Grain Marketing</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>29</td>
<td>100.0</td>
</tr>
</tbody>
</table>
LIST OF REFERENCES


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Chuatong, P. (1986). *Factors associated with the problem-solving ability of high school students enrolled in vocational horticulture.* Unpublished doctoral dissertation, Department of Agricultural Education, The Ohio State University, Columbus.


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