Aspired Cognitive Level of Instruction, Assessed
Cognitive Level of Instruction and Attitude Toward
Teaching at Higher Cognitive Levels

DISSERTATION

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

By

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* * * * *

The Ohio State University

1991

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This study is dedicated

. . . to my husband, Pat, for his patience, understanding,
emotional and spiritual support.

. . . to my daughters, D'Anne and Monica Jo, for their
endless supply of questions; affirming the importance of
studying the relationship between the thinking process and
teaching and learning.

. . . to my mother-in-law and father-in-law, Betty Lou
(Crumrine) and Paul Arthur Whittington, for their gifts of
love and encouragement.

and especially

. . . to my parents, Patricia Eileen (Godwin) and Gary Eugene
Quay, for never discouraging my plans to go to college, even
though it seemed only a dream. Maybe you knew that the faith
in God that you lived and modeled daily would, once again,
make the impossible, possible.

ACKNOWLEDGEMENTS

It is with deep appreciation that I acknowledge the Department of Agricultural Education for the financial assistance which made an advanced degree a reality. The following people are acknowledged for their vital role in the accomplishment of this work:

Dr. L. H. Newcomb, my adviser, mentor and friend. You are solely responsible for my internal drive for scholarship, without which, this document would never have been written. Thank you for persisting toward excellence. Thank you for laboring over each word as if it were your own and for sharing my pride in its completion.

Dr. Janet L. Henderson and Dr. "Mac" McCaslin for diligently and faithfully serving as my reading committee.

Dr. Robert Agunga, Agricultural Communication, and Dr. P. M. Clark, Psychology, for advising the support areas of my graduate program.

The friends, referred to as the graduate students in the Department of Agricultural Education from September 1, 1987 through June 14, 1991, a more hard working, conscientious, fun loving, and supportive group of friends could not have been hand-picked. You are the precious few who made graduate school bearable.

Dr. Charles Miller for assisting with data collection, reading rough drafts, listening and offering well-thought advice.

Ms. Cathy Martinez for patiently working as a research assistant to interview the participants and collect data.

Dr. Matt Raven for tutoring me through statistics.

Drs. Larry Miller, David McCracken, Kirby Barrick and Emmalou Norland for masterfully teaching the research series in Agricultural Education.

Dr. Jim Knight, for encouraging me to return to The Ohio State University to complete an advanced degree.

The students at Wellington High School who allowed me to be a part of their lives.

Debbie Waugh, for loving our children as her own.

Terri Foltz, J.D., for her love, tears, prayers, and encouragement as, together, we gave our best effort to balance school, work, church, and family for three tough years.

Beverly Newcomb, for her friendship and her love for my family which made the transition to Columbus, graduate school, and a new church a very pleasant and memorable experience.

My family, including my brothers and sisters, my nieces and nephews, my aunts and uncles, and my grandparents for loving me and for sacrificing a lot of "together" time--now we can catch up!

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Additional Articles - Not refereed but requiring acceptance by editors

Whittington, M. S. (1990). Retaining women in nontraditional
employment. The Agricultural Education Magazine, 63(2),
18-19, 23.

Whittington, M. S., & Knight, J. A. (1988). Toward sex
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Agricultural Education Magazine, 61(2), 17-18.

Whittington, M. S. (1987). Using SOE to increase enrollment.
The Agricultural Education Magazine, 60(1), 11.

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	iii
VITA.....	v
TABLE OF CONTENTS.....	vii
LIST OF TABLES.....	xiv
INTRODUCTION.....	1
CHAPTER	PAGE
I. INTRODUCTION.....	1
The National Context.....	1
An "Educated Person in the College of Agriculture.....	3
Professors Make the Difference.....	4
Teaching Thinking.....	5
Teaching Thinking in the College of Agriculture..	6
Statement of the Problem.....	8
Research Design.....	8
Limitations of the Study.....	10
Definition of Terms.....	10
Need for the Study.....	11
Research Needs.....	11
Aspiration Toward Teaching at Higher Cognitive Levels.....	12
Attitude Toward Teaching at Higher Cognitive Levels.....	13
Developmental Needs.....	14
Inservice Topics and Formats.....	14
Scholarly Teaching.....	15
Student Needs.....	17
Summary.....	18
II. REVIEW OF RELATED LITERATURE.....	20
A Goal of Education.....	20
Bloom's Classification of Thinking Skills.....	21
Challenges to the Taxonomy.....	22
Philosophical Concerns.....	22

Validity Concerns.....	23
Reliability Concerns.....	25
Summary of Bloom's Taxonomy.....	26
Intellectual Abilities and Skills.....	27
Attention to Thinking Ability.....	28
Cognitive Level of College Teaching.....	30
Cognition Research at The Ohio State University.....	31
Findings of Cognition Research at The Ohio State University.....	32
Barriers to Higher Level Teaching.....	33
Factors Which Influence Cognitive Levels of Thought.....	36
Cognitive Abilities Before Entering the Course.....	37
Instructor's Cognitive Expectations for the Course.....	38
Student's Previous Experience with the Course Content.....	39
Instructor's Interest and Previous Experience.....	40
Interest in and Value of the Course to the Student's Academic and Professional Career.....	41
Major Elements of the Environment.....	41
Mental Activities in Class.....	42
Mental Activities While Studying for the Course.....	43
Feelings About Courses.....	43
Patterns of Work Including Storing and Using Information.....	44
Extent of Class Participation and Quality of Participation.....	45
Class Size.....	46
Other Possible Influencing Factors.....	47
Cognitive Factors Examined in This Study.....	48
Cognitive Level of Instruction.....	48
Cognitive Level of Tests, Quizzes, and Assignments.....	50
Professors' Aspiration to Teach at Higher Cognitive Levels.....	52
Attitude Toward Teaching at Higher Cognitive Levels.....	53
Faculty Preference for Inservice Topics and Formats.....	54
Summary of Variables.....	55
Summary.....	56
III. METHODOLOGY.....	58
Introduction.....	58
Research Design.....	58
Population and Sample.....	60

Instrumentation.....	62
Letter of Invitation.....	62
Collecting Demographic Information.....	62
Measuring Professors' Aspiration to Teach at Higher Cognitive Levels.....	63
Development.....	63
Reliability.....	64
Validity.....	66
Measuring Assessed Cognitive Level of Instruction.....	66
Discourse.....	66
Reliability.....	69
Validity.....	70
Tests, Quizzes and Assignments.....	70
Development.....	70
Reliability.....	71
Measuring Attitude Toward Teaching at Higher Cognitive Levels.....	72
Development.....	72
Reliability.....	73
Validity.....	74
Preference for Inservice Topics and Formats for Teaching at Higher Cognitive Levels.....	74
Development.....	74
Reliability.....	75
Validity.....	76
Data Collection.....	76
Measuring Professor's Aspiration to Teach at Higher Cognitive Levels.....	76
Assessing Actual Cognitive Level of Instruction.....	78
Discourse.....	78
Tests, Quizzes and Assignments.....	80
Measuring Attitude Toward Teaching at Higher Cognitive Levels.....	80
Collecting Faculty Preference for Inservice Topics and Formats.....	80
Data Analysis.....	81
Analyzing Professor's Aspiration to Teach at Higher Cognitive Levels.....	82
Analyzing Cognitive Level of Discourse.....	83
Analyzing Tests, Quizzes and Assignments...	83
Analyzing Attitude Toward Teaching at Higher Cognitive Levels.....	83
Assessing Faculty Preference for Inservice Topics and Formats.....	84
Summary.....	84
IV. FINDINGS.....	86
Introduction.....	86

General Demographics.....	90
Personal Demographics.....	91
Teaching Demographics.....	92
Extent of Familiarity of the Participants with Levels of Cognition.....	95
Aspired Cognitive Level of Instruction.....	97
Cognitive Level to Which Participants Aspire for Their Discourse.....	97
Cognitive Level to Which Participants Aspire for Their Written Test Items.....	100
Cognitive Level to Which Participants Aspire to Write Their Quizzes.....	102
Cognitive Level to Which Participants Aspire to Write Their Assignments.....	103
Assessed Cognitive Level of Instruction.....	105
Assessed Cognitive Level of Discourse.....	105
Assessed Cognitive Level of Written Test Items.....	106
Assessed Cognitive Level of Quiz Items....	108
Assessed Cognitive Level of Assignments...	109
Discrepancy Between Aspired Cognitive Level of Instruction and Assessed Cognitive Level of Instruction.....	111
Discourse at the Remembering Level.....	112
Discourse at the Processing Level.....	113
Discourse at the Creating Level.....	114
Discourse at the Evaluating Level.....	114
Testing at the Remembering Level.....	115
Testing at the Processing Level.....	116
Testing at the Creating Level.....	117
Testing at the Evaluating Level.....	117
Relationship Between Aspired Cognitive Level of Instruction and Assessed Cognitive Level of Instruction.....	119
Attitude Toward Teaching at Higher Cognitive Levels.....	120
Relationship Between Aspired Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels.....	122
Relationship Between Assessed Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels.....	125
Relationship Between Demographic Variables and Attitude Toward Teaching at Higher Cognitive Levels.....	127
Preferred Inservice Topics and Formats for Reaching Higher Cognitive Level Instruction	129
Preferred Inservice Topics.....	129
Preferred Inservice Formats.....	131
Summary of Findings.....	132
Demographics.....	132
Aspired Cognitive Level of Instruction....	133
Assessed Cognitive Level of Instruction...	134

Discrepancy Between Aspired Level and Assessed Level.....	135
Relationship Between Aspired Cognitive Level of Instruction and Assessed Cognitive Level of Instruction.....	135
Attitude Toward Teaching at Higher Cognitive Levels.....	136
Relationship Between Aspired Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels.....	136
Relationship Between Assessed Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels.....	136
Demographic Relationships.....	137
Inservice.....	137

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.139

Purpose.....	139
Research Design.....	139
Population and Sample.....	141
Instrumentation.....	141
Aspired Cognitive Level.....	142
Assessed Cognitive Level.....	142
Attitude Toward Teaching at Higher Cognitive Levels.....	143
Demographic Information.....	143
Inservice Topics and Formats.....	143
Data Collection.....	144
Measuring Aspiration to Teach at Higher Cognitive Levels.....	144
Assessing Actual Cognitive Level of Instruction.....	144
Discourse.....	144
Tests, Quizzes and Assignments.....	144
Measuring Attitude Toward Teaching at Higher Cognitive Levels.....	145
Acquiring Demographic Information.....	145
Finding Preferred Inservice Topics and Formats.....	145
Data Analysis.....	146
Analyzing Aspiration to Teach at Higher Cognitive Levels.....	146
Analyzing Cognitive Level Instruction.....	147
Discourse.....	147
Tests, Quizzes and Assignments.....	147
Analyzing Attitude Toward Teaching at Higher Cognitive Levels.....	148
Analyzing Demographic Information.....	148
Determining Preference for Inservice Topics and Formats.....	148
Summary of Findings.....	149
Demographics.....	149

Demographics.....	149
Aspired Cognitive Level of Instruction....	150
Assessed Cognitive Level of Instruction....	150
Discrepancy Between Aspired Cognitive Level and Assessed Cognitive Level.....	150
Relationship Between Aspired Cognitive Level of Instruction and Assessed Cognitive Level of Instruction.....	152
Attitude Toward Teaching at Higher Cognitive Levels.....	152
Relationship Between Aspired Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels.....	152
Relationship Between Assessed Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels.....	153
Demographic Relationships.....	153
Inservice.....	153
Conclusions.....	154
Discussion.....	156
Cognitive Level of Discourse.....	156
Reaching Higher Cognitive Level Instruction.....	160
Prior to Teaching.....	160
In Class Learning Experiences.....	161
Testing.....	161
Assignments.....	162
Out of Class Learning Experiences....	163
Summary of Discussion.....	164
Recommendations.....	165
Recommendations for Instruction.....	165
Recommendations for Further Research.....	166
VI. APPENDICES.....	169
A. Correspondence.....	170
B. Instrument to Collect Demographics.....	183
C. Brief Plan.....	187
D. Instrument to Collect Aspired Cognitive Level of Instruction.....	196
E. Attitude Instrument.....	198
F. Inservice Instrument.....	203
G. Bloom's Taxonomy.....	206
H. Newcomb-Trefz Model.....	217
I. Florida Taxonomy of Cognitive Behavior....	227

J.	Observation Form.....	230
K.	Approximate Time Commitment.....	232
L.	Raw Data Recording Form.....	234
VII.	Bibliography.....	236

LIST OF TABLES

TABLE	PAGE
1. Piaget's Stages of Development.....	34
2. Comparison of Bloom's Taxonomy and the Florida Taxonomy of Cognitive Behavior.....	68
3. A Comparison of Bloom's Taxonomy, the Florida Taxonomy of Cognitive Behavior and the Newcomb-Trefz Model.....	77
4. Departmental Listing of Participants by Course Level Taught.....	91
5. Age of Participants.....	91
6. Rank of Participants.....	92
7. Teaching Demographics of Participants.....	93
8. Time Before Class Devoted to Preparing to Teach the Class Session.....	94
9. Tenure Status of Participants.....	94
10. Cognition Workshops Attended.....	96
11. Participation in Previous Cognition Research....	97
12. Cognitive Level of In-class Discourse to Which Participants Aspire.....	99
13. Cognitive Level to Which Participants Aspire to Write Test Items.....	101
14. Cognitive Level to Which Participants Aspire to Write Quiz Items.....	103
15. Cognitive Level to Which Participants Aspire to Write Assignments.....	104

16.	Assessed Cognitive Level of In-class Discourse.....	106
17.	Assessed Cognitive Level of Tests.....	108
18.	Assessed Cognitive Level of Quizzes.....	109
19.	Assessed Cognitive Level of Assignments.....	110
20.	Discrepancy Between Aspired Discourse Scores and Assessed Discourse Scores Across the Levels of Cognition.....	115
21.	Discrepancy Between Aspired Scores for Testing and Assessed Scores for Testing Across the Levels of Cognition.....	118
22.	Correlations Between Aspired Cognitive Level of Instruction and Assessed Cognitive Level of Instruction.....	120
23.	Participants' Scores for Attitude Toward Teaching at Higher Cognitive Levels.....	121
24.	Correlations Between Aspired Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels.....	124
25.	Correlations Between Assessed Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels.....	126
26.	Correlations Between Demographic Variables and Attitude Toward Teaching at Higher Cognitive Levels.....	128
27.	Preference of Participants for Inservice Topics.....	130
28.	Participants' Preference for Inservice Formats.....	132
29.	Comparison of Cognitive Level of Discourse Across Studies.....	158
30.	Comparison of Cognitive Level of Discussion Group Versus Lecture.....	164

CHAPTER I

INTRODUCTION

The National Context

These are challenging times for American education. America is caught in a sweeping wave of educational reform in higher education that is unprecedented in the history of the country. This intense national concern was sparked by five major national reports: 1) The National Institute of Education's "Involvement in Learning: Realizing the Potential of American Higher Education" (1984), 2) The National Endowment for the Humanities report entitled "To Reclaim a Legacy" (Bennett, 1984), 3) The Association of American Colleges Project report on Redefining the Meaning and Purpose of Baccalaureate Degrees, "Integrity in the College Curriculum" (1985), 4) The Carnegie Foundation for the Advancement of Teaching's "College: The Undergraduate Experience in America" (Boyer, 1987), and 5) The National Commission on the Role and Future of State Colleges and Universities report, "To Secure the Blessings of Liberty" (1986). Although differences exist between and among the reports, they all share the view that undergraduate education

in general is in need of reform, and that the general education component of the undergraduate experience has become incoherent and ineffective (Reagan et al., 1987).

The theme of the ineffectiveness of the undergraduate curriculum has been no different from the criticism of the American education system in general--failure to encourage students to think. During the past decade numerous government reports have openly criticized the American education system. Examples include the 1982 Education Commission of the States which reported, "the pattern is clear: the percentage of students achieving higher order thinking skills is declining" (Baron & Sternberg, 1987). In response to similar reports, education at all levels, (primary, secondary, and colleges and universities) is experiencing a reformation.

Like many other colleges and universities across the country, The Ohio State University is enthusiastically revising undergraduate curricula. The goal of the revision is to expand and enrich the intellectual experience of every undergraduate. To accomplish that goal educators are encouraged to design courses and programs that produce "educated persons" (Reagan et al., 1987). What is an "educated person"?

The Interim Report of the Special Committee for Undergraduate Curriculum Review (1987) lists the primary

characteristics of an "educated person" as the ability to write and speak, read and listen, and the ability to engage in careful logical thinking and critical analysis. Every college in the University is interpreting this definition and accepting the challenge to create new courses and revise existing programs to meet the needs of future "educated persons" in a modern society.

An "Educated Person" in the College of Agriculture

In accepting the challenge of the Reagan Report, while adjusting to meet the needs of an agricultural industry that increasingly requires more emphasis on science and technology and less on production, the College of Agriculture at The Ohio State University adopted a Strategic Plan (Warmbrod et al., 1989). The plan recommended that future "educated persons" in the College of Agriculture complete the following courses as part of the total undergraduate curriculum: biotechnology, systems analysis, ethical and public policy aspects of domestic and international agricultural systems, cultural and social aspects of agriculture, problem solving, leadership development, and computer applications.

The committee specifically emphasized science and technology, and analysis and problem solving as components in the curriculum of an "educated person". However, simply adding science and technology, and analysis and problem

solving courses to the curriculum will not bring about the primary characteristics of an "educated person". This researcher believes that it is the teaching of the curriculum of the future that will make the difference.

Professors Make the Difference

Faculty members are a valuable resource in the total agricultural system (Chudzinski, 1988). Their teaching must be effective and innovative to stay current in meeting both the needs of agriculture and the needs of students. In their classrooms, professors are the caretakers of a treasure that can strengthen agriculture, but more importantly, can prepare students for life. Professors can activate the human mind.

If one believes that daily experiences in the environment shape and mold the intellect, then one must believe that professors and their teaching play an important role in nurturing the thinking ability of students. The value of teaching is manifested in enhanced thinking ability of students. The Strategic Plan for the College of Agriculture addresses the teaching of thinking in the teaching function of the mission for the college:

To develop the scientific and technical knowledge of students and practitioners, enhance their individual and

collective capacity for enlightened thinking and problem solving, and encourage them to value and participate in the lifelong process of education (Warmbrod et al., 1989 p. 2).

Teaching Thinking

The power to think and solve problems should be the student outcome aspired by professors. Many educators (Black, 1952; Dewey, 1933; Boyer, 1987; Kurfiss, 1988) agree with Meyers (1986) who stated:

It is increasingly important that students master the thinking and reasoning skills they need to process and use the wealth of information that is readily at hand... (p. xii).

As early as 1929, Whitehead addressed the need to teach thinking skills, "The real fruits of education are thought processes." Lancelot (1929) put the need to teach thinking in its clearest perspective,

In general, those who succeed best in their undertakings, who are most efficient in their work, and who progress most steadily toward their chosen goals in life are the ones who think best while those people who are least efficient are, as a class, the poorer thinkers (p. 82).

American educators, however, have not been singled-out as exemplary models for teaching thinking. "Traditionally, instruction in how to think has been a neglected component in American education" (Halpern, 1984, p.ix). McKeachie contends that, "Everyone agrees that students learn in college, but whether they learn to think is more controversial" (Joscelyn, 1988). Thus, in teaching thinking, a discrepancy exists between what theorists believe "is" happening in college classrooms and what Reagan (1987) and others suggest "ought to be" happening in college classrooms.

Teaching Thinking in the College of Agriculture

Attention to studying the discrepancy between the level of cognition that "is" occurring in College of Agriculture classrooms as opposed to what "ought to be" occurring, resulted in research studies on the cognitive level of teaching and learning. Using The Taxonomy of Educational Objectives: Cognitive Domain, commonly referred to as Bloom's Taxonomy, (Bloom et al., 1956), a research study was conducted in 1986 in the Department of Agricultural Education at The Ohio State University (Newcomb & Trefz, 1987) that assessed cognitive levels of teaching as measured by the tests, quizzes, and assignments written by professors. Fifteen percent of the course activities were found to be

assessing students at the highest levels of cognition -- creating and evaluating.

In 1987 a master's thesis (Pickford, 1988) expanded the Newcomb & Trefz study by considering relationships between student achievement and selected variables. Assignments seemed to have had the greatest influence on student achievement across the levels of cognition, but a need existed to examine the area of cognitive levels of teaching and learning more thoroughly and to consider additional variables.

Miller (1989) continued work in the area of cognitive levels of teaching and learning. He extended the previous work and examined the relationship of additional course experiences, especially instructor discourse to student cognitive ability. The students' level of cognition was pretested and posttested on both subject matter and non-subject matter tests. Results of the study revealed that tests, quizzes, and instructor discourse were occurring at the lower levels of cognition. However, assignments seemed, once again, to be challenging students across the levels of cognition.

A synthesis of the three studies showed that students in the College of Agriculture at The Ohio State University were challenged to reach beyond rote memorization and comprehension through assignments. However, students were

not challenged at the application, analysis, synthesis, and evaluation (Bloom, 1956) levels through instructor discourse -- the experience which most exposes students to professors. Nor were students challenged at the higher levels of cognition through tests or quizzes -- the experience which, because of grades, most motivates students.

Statement of the Problem

In an attempt to contribute to the body of knowledge on cognitive levels of teaching, the purpose of this study was to describe the aspired cognitive level of instruction and assessed cognitive level of instruction and determine their relationship to attitude toward teaching at higher cognitive levels among selected faculty members in the College of Agriculture at The Ohio State University. This study also sought to discover preferences for inservice topics and formats designed to assist professors in reaching higher cognitive levels of instruction. The major variables of interest were aspired cognitive level of instruction, assessed cognitive level of instruction, and attitude toward teaching at higher cognitive levels.

Research Design

This research was descriptive - correlational in nature. Four instruments were utilized to present a detailed

explanation of each variable of interest and to answer the following research questions:

1. What are the characteristics of faculty members in the College of Agriculture at The Ohio State University who participated in this study in terms of:
 - a. general demographics
 - course level taught
 - subject matter taught
 - b. personal demographics
 - age
 - rank
 - c. teaching demographics
 - years of university teaching experience
 - percent appointment from general funds budget
 - number of courses taught per year
 - amount of time before class devoted to preparing for the class session
 - tenure status
 - d. extent of familiarity with levels of cognition
 - number of cognition workshops attended
 - extent of prior involvement in cognition studies
2. At what level of cognition do participants aspire to teach with respect to in-class discourse, written test items, quizzes and assignments?
3. At what level of cognition are participants actually teaching as determined by assessment of tests, quizzes and assignments, and assessment of in-class discourse as measured by the Florida Taxonomy of Cognitive Behavior?
4. What is the relationship between cognitive level of instruction to which participants aspire and actual cognitive level of instruction?
5. Among participants, what is their attitude toward teaching at higher cognitive levels?
6. What is the magnitude of the discrepancy between aspired cognitive level of instruction and actual cognitive level of instruction?

7. What is the relationship between aspired cognitive level of instruction and attitude toward teaching at higher cognitive levels?
8. What is the relationship between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels?
9. What is the relationship between demographic information collected and attitude toward teaching at higher cognitive levels?
10. What inservice topics and inservice formats are requested by participants to assist them in increasing their cognitive level of instruction?

Limitations of the Study

This study is exploratory in nature and thus employed only descriptive statistics.

The small sample size ($n = 10$) inhibits the strength of any relationships that were present in the study.

The process used to select the sample prohibited the researcher from generalizing the results of the study.

The researcher observed several participants classes on the same day of the week rather than randomly selecting days of the week to observe.

Definition of Terms

Percent appointment on general funds budget - proportion of full time equivalency paid for from the teaching budget.

Higher cognitive levels - The upper two levels in Bloom's Taxonomy of educational objectives in the cognitive domain (Bloom, 1956). The levels are labeled synthesis

and evaluating (see complete explanation of levels in Appendix G).

Lower cognitive levels - The lower six levels in Bloom's Taxonomy of educational objectives in the cognitive domain (Bloom, 1956). The levels are labeled knowledge, comprehension, application and analysis (see complete explanation of levels in Appendix G).

Familiarity with cognitive levels - Attendance at or participation in cognition workshops and cognition research provided through the Department of Agricultural Education.

Definitions -

Aspiration - the cognitive level at which participants in this study want to deliver their instruction.

Discourse - number of verbal statements at each level of cognition spoken during the class session.

Need for the Study

Research Needs

Currently, that which is known about the cognitive level of teaching and learning among College of Agriculture professors, is limited to three years of research in the College of Agriculture at The Ohio State University. Thus far, this research has: assessed cognitive levels of teaching and learning as measured by assessment of tests, quizzes and

assignments; examined relationships between student achievement and selected student and teacher variables; and appraised the level of instruction of professors' discourse. Each study has been valuable in contributing to knowledge, but this preliminary foundational work needs to be extended.

Aspiration Toward Teaching at Higher Cognitive Levels

Previous research suggested that generally professors tended to teach at lower levels of cognition (Newcomb & Trefz, 1987; Pickford, 1988; Miller, 1989), but very little has been done to determine the level to which professors aspire to teach. If this research confirms that professors teach at lower cognitive levels, and reveals low correlations between levels to which professors aspire to teach and assessed level of teaching, researchers could state, confidently, that a discrepancy exists between aspired and existing performance, hence professors aspire to raise their cognitive level of teaching. On the other hand, if lower levels of teaching are indeed prominent and if high correlations exist between levels to which professors aspire to teach and assessed level of teaching, researchers could state that no discrepancy exists between existing performance and aspirations of professors.

Probing such findings is worthy. Do professors aspire to teach at higher levels or are professors content with

their existing level of teaching? This question must be answered before researchers can hope to implement their findings.

Attitude Toward Teaching at Higher Cognitive Levels

Likewise, probing professors' attitudes toward teaching at higher cognitive levels is necessary. No research has measured attitude of professors toward teaching at higher cognitive levels.

A sample of professors in the College of Agriculture at The Ohio State University has indicated displeasure with their assessed level of teaching and has indicated an interest in changing (Newcomb & Trefz, 1987). It must be determined whether this point of view is shared by other professors. If professors' attitude scores toward teaching at higher cognitive levels are low, what assistance can be offered to raise the cognitive level to which they aspire? This study will assist in answering the question and hence enhance understanding of the needs in this area.

On the other hand, if high correlations between aspired cognitive level of teaching, assessed cognitive level of teaching, and attitude are found, why are professors' attitude scores high? Are attitude scores high because professors are confident that students are graduating from their courses equipped with the proper balance of knowledge

and skill in that subject matter area? Are professors' attitude scores high because they are unaware of cognitive levels of teaching and learning, and therefore oblivious to teaching at higher levels? Maybe professors are aware that higher levels exist, but are content with their actual level because they are reluctant to change. Professors could be uncertain of executing drastic changes in their teaching based on preliminary research.

The academy needs a better understanding of professors' points of view in the area of teaching and learning at higher cognitive levels. Gaining such an understanding would be a valuable contribution of this study.

Developmental Needs

Inservice topics and formats

Not only will this study impart knowledge by building upon previous research, it will also contribute to improved teaching by examining developmental needs of professors. In a land-grant institution where the proper balance between teaching, research, and service is constantly being sought, yet seldom achieved, professors must be given opportunities to request assistance in an area that is often neglected -- teaching.

The Strategic Plan for the College of Agriculture (Warmbrod et al., 1989) lists as one of its needs, "a renewed

commitment to undergraduate teaching and advising". An Assessment of Undergraduate Education in American Colleges of Agriculture (Love & Yoder, 1989) lists as one of its recommendations, "intensive training programs whereby faculty could learn improved techniques for advising and teaching students". Chudzinski (1988), in the National Assessment of Faculty Development Needs suggested that there is a need for greater attention to faculty development, renewal and redirection in teaching.

The concerns presented by these authors are pressing. An outgrowth of this study will address these pressing concerns among professors regarding developmental needs--especially teaching.

Scholarly teaching.

Scholarly teaching is especially important during this period of undergraduate curriculum revision. In a University Council on Vocational Education Visiting Scholar presentation, Dr. J. Robert Warmbrod, Acting Vice President and Dean for Agricultural Administration at The Ohio State University, listed three aspects of teaching that demonstrated the scholarly component of teaching. Among the aspects was the ability to promote critical analysis, a thinking ability that Bloom (1956) labeled, "intellectual skills", or the upper levels of the hierarchy.

It has been suggested that many professors are unaware that they can teach across the levels of the hierarchy. More specifically, they are unaware that various cognitive levels of teaching and learning exist.

Instructors, for the most part, appear to be unaware of the fact that various types of discourse, test questions or assignments can prompt student thought at various levels of cognition (Miller, 1989 p. 175).

This study presents a needed opportunity for faculty awareness regarding cognitive levels of teaching.

However, if professors are presented chances to learn more about cognitive levels of teaching, and are informed of the methods of teaching available for enriching classroom experiences, will they be more apt to incorporate practices of higher level thinking into their instruction? According to Atkin (1989), "Not much progress in education is likely to take place unless teachers become agents in the improvement of their own practice" (p. 204).

Among professors who, through previous exposure, are aware of cognitive levels of teaching and learning, there is a need to promote the teaching of thinking. Professors who encourage students to solve problems, create, and evaluate independently should not go unnoticed. This study will examine the practices of professors who are teaching at

higher levels of cognition and will highlight their work during workshops and inservice experiences.

Student Needs

If one believes in a hierarchy of thought processes then one must believe that teaching facts provides an essential base for preparing students to operate at the comprehension level, then the application level, and on through the hierarchy to the evaluation level. However, if students are to perform at the application, analysis, synthesis and evaluation levels, then instructors must first model these higher level thought processes. In modeling these higher order processes, professors will have taken the first step toward moving students to higher cognitive levels of thinking. Only then can students begin to appreciate and benefit from learning across the hierarchy. According to Miller (1989),

...it appears that until instruction at higher levels of cognition takes place in the College of Agriculture, it is unlikely that notable improvement in student performance at higher levels of cognition will be evidenced (Miller, 1989 p. 175).

Students seem to be motivated to learn at the cognitive level that is emphasized on the test (Pickford, 1988). However, assignments, not tests, are the major sources for

opportunities to practice at higher levels of cognition. Previous research shows that assignments are weighted proportionally less than tests in determining final grades for courses. Hence students may not benefit as much from the higher level thinking associated with assignments as could be possible. If more were known about cognitive level of assignments and proportional weighting of assignments versus tests, instructors could be challenged to find the combination that would offer students both the opportunity and the motivation to practice higher level thinking skills.

Summary

Students in colleges of agriculture cannot be stifled educationally by professors who encourage thinking at the lower levels of cognition, and seldom reach the higher levels. According to Pickford, "...students need to develop their cognitive skills and abilities because of the demands of employment and to function as a citizen in a democracy" (Pickford, 1988, p. 107).

A knowledge base in agriculture is essential, but the learning must go beyond memorizing facts to practicing higher level thinking skills such as application of facts, analysis of trends, synthesis of information into new forms, and evaluation of products and processes. These are the skills needed to meet the demands of a changing agriculture. More

importantly, these are the skills needed to strengthen quality of life on a daily basis.

The results of this study will enhance the ability of professors to strengthen the skills needed by students. The results of this study will also provide a basis for making further recommendations related to improved teaching and learning in higher education.

CHAPTER II

REVIEW OF RELATED LITERATURE

A Goal of Education

Professors often fall short of encouraging students to think beyond rote memorization of facts. Granted, fundamental instruction focusing upon facts, dates and theories is necessary and provides students with an essential foundation for further learning , but the mere knowledge of facts is not a sufficient goal in education (Newcomb and Trefz, 1987; Cano, 1988). According to Bender (1965), the ability to transfer knowledge and skills learned to other situations is the implicit goal of any educational endeavor.

Systems which classify thinking skills into several levels have been developed which suggest that a simple transference of knowledge is a lower level thinking skill and that students should be challenged to master higher level thinking abilities. Gibson and Chandler (1988) wrote that a goal of education was to challenge students "to learn how to apply facts in new situations, to analyze and synthesize the information they take in, and, finally to make judgements about what they have found" (p. 433). Their opinion of the

goal of education was derived from a classification system for thinking skills developed by Benjamin Bloom (1956).

Bloom's Classification of Thinking Skills

The Taxonomy of Educational Objectives: Cognitive Domain developed by Bloom, Engelhart, Furst, Hill and Krathwohl (1956), was built on a theory of varying levels of complexity (Pickford, 1988) in which cognitive thought and associated behaviors could be classified into six hierarchical levels (Cano, 1988). In the hierarchy, students were encouraged to think beyond the two lower levels of mental processing, "knowledge" and "comprehension", to the higher levels of, "application", "analysis", "synthesis", and "evaluation".

Bloom (1956) argued that accomplishing higher order thinking (application, analysis, synthesis and evaluation) required some analysis or understanding of the new situation; it required a background of knowledge or methods which could be readily utilized; and it also required some facility in discerning the appropriate relations between previous experience and the new situation. Thus, Bloom contended that mere knowledge of facts must be present before the ability to transfer knowledge could be achieved. A detailed description of Bloom's Taxonomy is provided in Appendix G.

Bloom's Taxonomy has been used in hundreds of research projects since its inception (Furst, 1981). Research and scholarly writings concerning Bloom's Taxonomy offer evidence that it is a valid and reliable means of classifying cognitive behaviors and serves as a valuable tool for educators (Willson, 1973; Furst, 1981).

Challenges to the Taxonomy

Despite high acclaim for Bloom's Taxonomy, it is not without criticism. The Taxonomy has been challenged philosophically. It has also been challenged regarding validity and reliability. This section addresses those concerns.

Philosophical Concerns

Philosophically, educators and psychologists argue whether Bloom's Taxonomy represents a prescriptive or descriptive model of human thought (Sternberg, 1985). Furst (1981) faulted the Taxonomy for failure to distinguish between "behavioral and substantive (content) elements in statements of educational objectives" (p. 443). Furst raised further concerns regarding the implied distinction between the cognitive and affective domains of thought (Miller, 1989). However, one of the strongest areas of philosophical

criticism concerning the Taxonomy focused on the cumulative hierarchical structure of the model (Furst, 1981).

Phillips and Kelly (1975; cited in Miller, 1989) considered the hierarchical structure to be too simplistic for guiding educational theories. Scholars (Pring, 1971; Orlandi, 1971; Purves, 1971; Moore and Kennedy, 1971) argued that demonstration of some lower level cognitive behaviors required mental operations at higher cognitive levels which were not being observed, but research has failed to conclusively substantiate or refute this concern (Miller, 1989, p. 16).

Validity Concerns

Consideration of the validity of the hierarchical structure is critical in order to determine the validity of the taxonomy as a whole (Miller, 1989). In a three year comprehensive study of 1,000 high school students, Kropp and Stoker (1966) concluded that their findings supported the imputed theory of the hierarchical structure. They reported, however, a lack of conformity at the evaluation level.

Miller (1989) summarized a study by Madaus, Woods, and Nuttall (1973) stating that the researchers found direct links between the four lower levels of the taxonomy (knowledge, comprehension, application, and analysis). A

weak direct link between the analysis and synthesis levels was also found. The direct link between the top two cognitive levels (synthesis and evaluation), while found to exist, was the weakest of all observed.

An extant hierarchy among the first four levels was found by Miller, Snowman, and O'Hara (1979). However these researchers found the application level to have two direct links rather than one; application-analysis and application-synthesis levels were directly linked. These researchers also found a linear relationship between synthesis-evaluation.

Even though these two pieces of research supported the hierarchy at the first four levels, a study by Ormell (1974) contradicted that finding. Ormell suggested that in some cases demonstrating knowledge required more complex thought processes than demonstrating analysis or evaluation (Miller, 1989). Kunen and others (1981), concluded that the synthesis and evaluation categories were found to be in the wrong order in a number of studies (Cano, 1988). Stedman (1973) reported no significant difference between knowledge and comprehension or comprehension and analysis.

Reliability Concerns

Reliability concerns focus on the effectiveness of the Taxonomy as a tool for communicating among educators (Pickford, 1988). A number of studies have reported no significant differences between or among the classifications made by observers in each of the studies (Clegg, Farley, and Curran, 1967; Stoker and Kropp, 1964; Stanley and Bolton, 1957; cited in Miller, 1989). Davis (1969) and Fairbrother (1975) reported consistent classifications made by observers in their studies with those made in previous studies.

While Fairbrother and others found consistency in the use of Bloom's Taxonomy by observers, they raised questions as to the consistency of meaning of the categories from study to study (Pickford, 1988; Miller, 1989). Consequently, interpretation was often restricted to individual studies. According to Pickford (1988), the reliability and communicability of Bloom's Taxonomy was closely linked with the training of raters.

Yet another concern was the utilization of the Taxonomy across grades and subject areas. Furst (1981) argued that instruments should be used that were subject specific. Kropp and Stoker (1966) however, concluded that the Taxonomy could be generalized across grades and subjects at least at the

high school level, especially the knowledge and evaluation categories.

According to Miller (1989), a final major issue regarding reliability of the Taxonomy was the ability of the observer to accurately assess intended student behaviors. To minimize this concern, Furst (1981) recommended that teachers be used to judge the level of test items since teachers had knowledge of the students and the conditions of instruction. Gall (1970) further suggested that control of lesson material by the researcher was a means whereby researchers could more accurately determine the level of test questions they classify.

Summary of Bloom's Taxonomy

Furst (1981) noted that the Taxonomy, while imperfect, offered a practical means for organizing the cognitive domain of thought. Of the Taxonomy, Biggs (1979) wrote, it is the "best known systematic attempt to provide structure for assessing levels of learning quality...".

Use of Bloom's Taxonomy as a framework for levels of thinking provides focus and direction for teachers interested in improving the quality of learning in their classrooms (Newcomb and Trefz, 1987; Cano, 1988). This could be accomplished by analyzing and evaluating tests and quizzes,

assignments, and classroom discourse, in terms of the level of cognitive processing demanded from the student. For these reasons, Bloom's Taxonomy provided a theoretical foundation for this study.

Intellectual Abilities and Skills

Bloom (1956), named the process of progressing through the steps in the hierarchy, growth in "intellectual abilities and skills". Some authors have labeled these same skills as "productive thinking" (Wertheimer, 1945), "critical thinking" (Black, 1952; Ennis, 1962; Meyers, 1986), "reflective thinking" (Dewey, 1938), "higher order thinking" (Beyer, 1987; Mauter, 1988), and "problem solving" (Dewey, 1933; Bloom, 1971). Although no general agreement on terminology had been reached, Beyer (1987) suggested that while problem solving, critical thinking, decision making, and creative thinking were sometimes used synonymously, they were not the same. Each of these skills, however involves higher order thinking skills and contains some of the same thinking operations. Bloom (1956), stated that all of these skills referred to:

the expectation that when a student encounters a new problem or situation, he/she will select an appropriate

technique for attacking it, and will bring to bear the necessary information, both facts and principles (p. 38).

Attention to Thinking Ability

The type of thinking ability referred to by Bloom (1956) has always received much attention in educational literature. As early as 1651 Thomas Hobbes wrote guidelines for the improvement of thinking (Russell, 1956). Three hundred years later Hobbes's writings were applied by Earhart (1908) and McMurry (1909) in two early books that contained helpful suggestions for people interested in the application of thinking. Later, in 1933, Dewey stated, "we all acknowledge, in words at least, that ability to think is highly important; it is regarded as the distinguishing power that marks man off from the lower animals" (p. 17).

In 1944 Lancelot wrote:

a first law of good teaching is that all 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.

Black (1952) stated, "the study of any subject calls for thought, and every student is, or ought to be a thinker..." (p. 3). In 1961 the National Education Association reported,

"the purpose which runs through and strengthens all other educational purposes - the common thread of education - is the development of the ability to think".

While these ideas had been espoused for decades, the 1960's launched the cognitive revolution. During this decade a number of studies indicated that the objectives teachers set and the questions teachers asked most frequently were of the lowest intellectual order, requiring little more than the recall of memorized materials (Floyd, 1961; Gallagher, 1965; Davis & Tinsley, 1967; cited in Cano, 1988).

With the added findings of the 1960's, the educational literature of the 1970's was proliferated with writings concerning the importance of teaching students to think. During the decade of the 1980's, the trend toward teaching critical thinking continued. Kurfiss (1988) wrote:

Most colleges and universities aspire to produce graduates who think critically, who can make judgements in complex situations on the basis of sound reason, adequate evidence, and articulated values (p.iii).

As a result of the National Commission on Excellence in Education (1983), however, attention to intellectual abilities and skills became more intense. Given decades of literature addressing concern for teaching students to think,

the Commission still heard evidence that indicated that many students did not possess "higher order" intellectual skills (p. 9).

Cognitive Level of College Teaching

Limited research has been conducted on the cognitive levels of college teaching, but the research which has been reported indicates that a preponderance of oral presentations by teachers as well as the textbooks and examinations associated with teaching typically reflect thinking at the lower levels of cognition - knowledge, comprehension, and application (Miller, 1989).

Fischer and Grant (1983) found that discourse in college courses was predominantly at the lowest levels of cognition irregardless of the kind of institution, the course level, the subject area or the length of time in session. Other researchers studying the thinking skills of college students found similar results.

According to Perkins (1985), "Depth of argument on controversial topics is minimal and increases marginally as a result of college instruction". Keeley, Browne, and Kreutzer, (1982) suggested, "seniors are more adept than freshmen at evaluating position papers, but their overall level of performance is low". Welfel (1982) stated that

"compared to freshmen, seniors in liberal arts and engineering are more aware of evidence in reasoning, but they still believe judgement is a matter of "individual idiosyncrasies".

Several researchers (Belenky, et al, 1986; King et al, 1983; Welfel, 1982) reported that college students made judgements on the basis of unexamined personal preferences, even after four years of higher education. Longitudinal studies showed an influence of education, but when reasoning about everyday questions, such as bias in the news and evaluation of food additives, only graduate students seemed to recognize that different points of view could be compared and evaluated through contextual reasoning (King, Kitchener, and Wood, 1985).

Cognition Research at The Ohio State University

At The Ohio State University, Newcomb and Trefz (1987) purposefully sampled 22 professors in the College of Agriculture. Using a modification of Bloom's Taxonomy, the researchers found that 37% of the learning in the courses studied was classified at the remembering (the lowest) level. The researchers reported that 61% of freshman/sophomore tests and quizzes were classified at the remembering level, but

out-of-class assignments and activities were classified at the higher levels of cognition.

Subsequently, Pickford (1988), expanded the Newcomb & Trefz study by considering relationships between student achievement and selected variables. Most recently, Miller (1989), researched aspects of the previous studies while examining additional course experiences, especially instructor discourse. The students' levels of cognition were pretested and posttested using both subject matter and non-subject matter tests.

Findings of Cognition Research at The Ohio State University

Two emerging themes were prevalent across the cognition research in the College of Agriculture at The Ohio State University. First, instructor discourse occurred, almost exclusively, at lower levels of cognition. Thus, limited opportunities for learning were provided at the creating and evaluating levels. Second, assignments far exceeded other variables on assessing students at the higher levels of cognition. Even so, when opportunities for higher level learning were provided, based on proportion of students total grades, the opportunities were not weighted as highly as tests or examinations.

An additional theme converging from two of the studies suggested that the cognitive level of performance expected by instructors on tests and quizzes was comparable to the instructors' cognitive level of discourse. One researcher stated, "instructors who taught at higher levels of cognition expected a higher degree of cognitive performance from their class" (Pickford, 1988).

Thus, after literally years of writings suggesting what ought to be accomplished in classrooms, researchers have discovered a discrepancy; the teaching of thinking which should have been taking place in classrooms has not been achieved. Several educators and researchers have suggested barriers which appear to interfere with the teaching of thinking.

Barriers to Higher Level Teaching

"'Easier said than done' The old motto probably applies to no activity with greater force than it does to instruction in thinking" (Russell, 1956, p. 333). Teaching students to think is difficult for various reasons. This section merely lists a few of the possibilities.

As early as 1933, Dewey, wrote that it was wholly futile to urge students to think when they had no prior experiences that involved some of the same conditions. Russell (1956)

suggested that thinking activities must include content involving the student's specific concern. Along with these authors views was that of Piaget (1971) who believed that students developed thinking in stages (see Table One).

Although Piaget's stages end at age 18, it is relevant to barriers faced by college professors in the following way. Piaget stated that few humans actually reach formal operations and that teachers should not assume that all teenagers nor all adults function at the formal level. He argued that there was little sense in trying to teach preoperational or early concrete thinkers to think abstractly

Table 1

Piaget's Stages of Development

AGE	STAGE
0-2	Sensorimotor
2-7	Preoperational
7-11	Concrete operations
11-18	Formal operations

Note. Sprinthall, 1987

and suggested that the only notable increases may be in pupil frustration, anxiety, and perhaps rote memorization

(Sprinthall, 1987, p. 113). Teachers, therefore, must be cautioned to teach at the operating level of the student, but to challenge them at a pace that stimulates increased higher order thinking.

Kurfiss (1988) suggested greater barriers to critical thinking. First, critical thinking was opposed by students because it was difficult. Hilgard (1948) pointed out that students did not want to understand completely what happened behind the process; they only wanted the tools necessary to reach immediate goals.

Secondly, critical thinking was opposed by teachers because it was tedious to grade and quantify. Kurfiss (1988) reported that grading of higher order thinking was often subject to debate.

Russell (1956) wrote that thinking was difficult to teach because it was not a purely intellectual process. He suggested that emotional and personal factors, of which the teacher had no control, affected all thinking processes.

Others have suggested additional barriers. For example, the teaching of thinking may mean that more time must be spent on a particular topic than seems reasonable. Another barrier -- students could feel a sense of injustice if they were tested at the creating and evaluating levels when objectives did not indicate such higher level behaviors were

expected. Also, professors could become discouraged when initial attempts by students to think and write at higher levels of cognition reflected inexperience. Professors could realize that considerable effort on their part may not result in an immediate, apparent change in the thinking behavior of the student.

Thus the challenge of teaching at higher levels of cognition could result in professors becoming frustrated and discouraged; frustrated over changing their own teaching behaviors and discouraged over changing their students' thinking behaviors. Even so, it is imperative that professors pursue the challenge since teaching students to think at higher cognitive levels will insure professors that their teaching will endure throughout a student's lifetime.

Factors Which Influence Cognitive Levels of Thought

"While it is important to consider the levels of cognition at which teaching and learning are occurring, it is erroneous to assume that such research alone will result in the eventual improvement of cognitive performance by students. There are numerous complex factors which appear to affect student cognitive performance (Pickford, 1988)" (Miller, 1989, pp. 25).

A number of authors have suggested factors which influence students' intellectual ability to operate at various levels of cognition. Several factors will be addressed in this review, all of which offer teachers insight into assisting students in reaching higher level thinking.

Cognitive Abilities Before Entering the Course

Whether a result of heredity or environment, whether a result of early experience, primary school or secondary school, the fact remains that students bring pre-determined cognitive abilities into college classrooms. The author of this document is interested in encouraging students to reach higher cognitive levels in college classrooms. Knowledge of influences from early experiences is informative, stimulating, and, according to Sprinthall (1987), reveals the true depth with which experiences shaped the intellect of the student before enrolling in a college course:

...for many years now early experience has been considered critical in shaping emotional development, psychologists have only recently come to recognize the importance of these same years to intellectual development (Sprinthall, 1987, p. 67).

According to theorists, early experiences simply prepared the child to profit fully from the educational

experience. Educational experiences picked up where early experiences left off. Hence, if students' environments had not exposed them to a balance of experiences and guided reflection in all areas of human activity, it was highly likely that cognitive development could be incomplete when students arrived in college classrooms. When cognitive development is incomplete, it seems that reaching higher cognitive levels may be more difficult.

Instructor's Cognitive Expectations for the Course

The concept of expectations has been researched for several years. Rosenthal and Jacobson (1968) suggested that teacher expectations were a powerful determinant of student performance, so much so, that the expectation could become an accurate predictor. The work of Beez (1968) and Brophy and Good (1970) supported Rosenthal and Jacobson (1968).

In 1977 Shaughnessy stated that expectations of learners and teachers powerfully influenced what happened in school. Moody (1982) wrote that at the outset of any course, the student should understand the content of the course and the level of mastery expected.

Although extensive research has been conducted concerning expectations, very few research projects have studied cognitive expectations. A study by Pickford (1989)

was the exception. Pickford (1988) found that instructors with higher cognitive expectations provided students greater opportunity for higher cognitive achievement on both the final examination and on tests and assignments.

Students Previous Experience with the Course Content

McKeachie (1980), felt that background of the student in the subject matter area was probably more important than the student's level of intelligence. Although level of intelligence is a measure of general intelligence, not necessarily higher level thinking, it seems parallels could be drawn. The following studies address general intelligence.

Poland, Williams, Whigham & Mullen (1982) concluded that a student's performance in an introductory crop production course was related to previous experience with farm machinery and crops. In addition, the researchers, in a separate study in 1982, found that years of high school vocational agriculture machinery operation experience and crop-related experience were related to student achievement in an introductory crop production course.

However, Anderson and Elkins, (1978) reported that earlier farm experiences did not significantly influence student performance in an introductory field crop production

course. In 1987, Lawrence, found that students' prior experience had no effect on their final grade in a light horse management class.

The previously listed studies refer to student achievement in general (without regard for cognitive level of achievement). Where cognitive level of achievement is concerned, Pickford (1988) appears to be the single study from which to draw conclusions. Pickford (1988) concluded that students' cognitive level of achievement did not appear to be highly related to students' previous experience.

Instructor's Interest and Previous Experience

The following studies address relationships between various types of instructor's interest and experience and student achievement in general, without regard for the cognitive level of achievement. A study by Mastin (1963) reported that in 19 out of 20 classes in 10 schools, an enthusiastic teacher was associated with high student achievement. Kittell and Moore (1983) reported that motivation reflected an instructor's enthusiasm for the course. Fincher (1977) addressed previous experience when it was suggested that the number of years teaching the course may account for the student's level of achievement.

Pickford (1988) reported findings for cognitive level of achievement. She found a substantial negative relationship between instructor's previous experience scores and students' cognitive level of achievement scores (p. 119). However, Pickford suggested caution in interpretation because of confounding influences of final examinations.

Interest in and Value of Course
to the Student's Academic and Professional Career

Lawrence (1987), in a study of 239 students in a light horse management course, found that those who indicated they were interested in the course for career purposes had a higher final grade (without regard for cognitive levels) than those who described their interests as hobby or casual. Taking cognitive level into consideration, Pickford (1988) found a substantial positive relationship between students' cognitive level of achievement and interest in and value of the course. The author, however, reported that students' cognitive level of achievement appeared to be unrelated to interest in and value of the course (p. 123).

Major Elements of the Environment

Chickering (1972), suggested that cognitive levels of students were effected by major elements of the environment.

Some of the environmental influences included: mental activities in class, mental activities while studying for courses, reasons for studying, feelings about courses, patterns of work, and role of the teacher.

Mental activities in class

Norman (1980) wrote, "What goes on in the mind of the learner? More than you might realize; more than you might wish" (p. 48). The early work of Bloom (1954), through simulated recall of college students, found that during a class students were thinking about various items of interest. Some students thought about the idea under consideration either actively or passively. At the active level students were comprehending, problem solving, and evaluating. At the passive level students were following the overt activity of the class.

Bloom found that students often thought about a related idea, the classroom situation or process, themselves, the instructor, or another student in the class. Students sometimes were engaged in thoughts about an object within sight or hearing, or some person or concrete object or situation not in the immediate environment. Bloom reported that students sitting in classes thought about some word or phrase. They also thought about feelings of boredom, or

states of confusion. Schultz (1953) found that "most of the thoughts reported by students could be traced directly to stimuli in the classroom environment."

Mental activities while studying for the course

Chickering (1972) found that mental activities used during outside-study varied in ways consistent with mental activities used in class. When passive tasks of listening and taking notes predominated, class preparation time was spent in memorization; synthesizing ideas or information, applying concepts or principles to new problems, and interpreting were slighted. Where listening, talking, and thinking were more evenly balanced, less time was spent in memorization and more on higher level mental activities.

Biggs (1979) reported that students' studies centered around avoiding failure, thereby making them syllabus-bound. Biggs said that students studied only what they had to, and then with a view to fairly accurate reproduction, rather than to transformation and internalization.

Feelings about courses

Fincher (1977) reported that the learning of college students could be facilitated by the motives and expectations that students brought to class. McKeachie and Webster (1960)

wrote, "it is generally realized that cognitive and intellectual aspects of personality are functionally related to affective or motivational states" (p. 324). Pintrich (1988) contributed to the suggestions of other authors by stating that motivation was often inappropriately omitted from models of students' critical thinking. Pintrich added that acquisition of knowledge and skills across cognitive domains required that the learner be motivated.

Patterns of work including storing and using information

Haber (1983) suggested that a critical component in cognitive skill was attention; information not attended to immediately, was likely to be lost. Bransford (1989) also advocated that new knowledge had to be actively constructed by learners. Hasher and Zacks (1971) however, believed that under certain circumstances it was possible to activate a process whereby some information from the environment could be automatically encoded without either attention or intention.

Piaget (cited in Furth, 1981) referred to information storage as "accommodation and assimilation".

Assimilation - taking into one's mind all new experiences without consideration for whether or not

they fit. Thinking as assimilation is more like daydreaming or imagining.

Accommodation - thinking about a new experience or idea, but not letting it into the consciousness. An example of pure accommodation is a student who memorizes a string of abstractions without any understanding. The words are said but the meaning is not there.

Extent of Class Participation and Quality of Participation

Extent of class participation and quality of class participation have both been shown to have high correlations with grade averages. Chickering (1972) found that when listening and taking notes occupied a large proportion of class time, participating in discussion, presenting reports, and making speeches occupied little. Based on Piaget (1970) who advocated activity as the means to cognition, it would appear that classes with more listening and note taking and less activity encouraged lower level thinking.

However, Bloom (1954) cautioned against substituting speaking in class for activity. He wrote that a mistake would be made to regard those students not speaking in class as doing nothing of importance. "Thoughts that students had during class should assume a high degree of importance for

inquiry into the learning process". Bloom further contended that the conditions under which the group was established and organized largely determined the thoughts the individual was free to verbalize as well as those which must be kept hidden.

Class Size

Bloom (1954) reported that passivity permeated a lecture to a greater extent than it permeated a discussion-type setting. He suggested that in a large lecture hall a student remained inconspicuous, but in a smaller group the student was constantly threatened by the chance of being called upon to respond. Smaller groups also cultivated the opportunity to keep-up with and compete against other members of the class.

In addition, Fischer and Grant (1983) and McKeachie and Kulick (1975) found that higher cognitive levels of student discourse were associated with small class size. On the other hand, Chickering (1972) stated that analyzing ideas presented, thinking of implications, checking for soundness, and mentally criticizing could occur during a lecture or a discussion.

Other Possible Influencing Factors

Studies imply strongly that the quality of classroom interactions was dependent on the activities of both the students and the instructors (Goodwin and Klausmeier, 1975). Listed in this section are other student factors, which possibly contribute to higher cognitive levels, but which scarcely appear in the literature: class attendance, keeping up with reading assignments (including reading the assignment before class as opposed to after class), hours per day spent in study time, and age of student (Pickford, 1988).

Other possible instructor factors which have been said to influence student growth across cognitive levels include: classroom climate (Anderson, 1970; Walberg and Anderson, 1968) amount of classroom discussion (Gall et al. 1970, 1976, 1978), sequence and types of questions (Ryan, 1973, 1974), student encouragement (Smith, 1977), teacher methods and strategies (Joscelyn, 1988), and student-centered versus teacher-centered classes (McKeachie and Kulick, 1975; Pickford, 1988). Each factor listed offers an opportunity for further research into teaching and learning across cognitive levels.

Cognitive Factors Examined in this Study

Numerous factors have been suggested as contributing to student performance at higher cognitive levels. This study will focus on four variables which attempt to discover new knowledge concerning professors' cognitive levels of teaching. This study will also parallel earlier research with hope of furthering the understanding of previous findings.

The variables in this study include: cognitive level of instruction (including discourse, cognitive level of examinations, tests, quizzes and assignments), professors' aspiration to teach at higher cognitive levels, professors' attitude toward teaching at higher cognitive levels, and assessment of professors' needs as they relate to increasing the cognitive level of instruction. This section will discuss each of the variables. Instrumentation and methodology will be fully explained in Chapter III.

Cognitive Level of Instruction

Since 1900 researchers have attempted to evaluate teaching performance without much success (Flanders, 1970). Morsh and Wilder (1954) in a review of literature concerning teaching performance, concluded that, "No single, specific, observable teacher act has yet been found whose frequency or

percent of occurrence is invariably (and) significantly correlated with student achievement..."

However, studies have clearly shown that the quality of the educational experience influenced both rate and maximum level of cognitive growth achieved by individuals (Sprinthall, 1987). At least a portion of quality educational experience was dependent upon instruction. Cross and Angelo (1988) stated that, "...all teachers are interested in the cognitive growth and academic skills of their students" (p. 15).

The instructional theory of Fischer and Grant (1983) suggested that a professor's basic purpose was to guide students in obtaining knowledge and intellectual skills, and methods of processing ideas. Verbal discourse was one vehicle available to professors for accomplishing the stated purposes, yet in studying verbal discourse, Fischer and Grant (1983) found it to be at lower cognitive levels. However, Schultz (1953) reported that the verbal activity of the instructor and the students were dominant factors in achieving higher cognitive levels.

Studies of the relationship between verbal discourse (including questioning) and higher cognitive levels of student performance, with elementary students and teachers, have been conducted by several researchers. The results have

been varied. Some authors found verbal discourse to contribute to higher student cognitive levels (Taba, 1966; Ryan, 1973 and 1974; Gall et al. various years) while others found no significant changes in student cognitive performance (Hunkins, 1968; Rogers and Davis, 1970; Buggey, 1972). Pickford (1988) reported a low correlation between cognitive level of discourse and cognitive level of student performance.

The Florida Taxonomy of Cognitive Behavior, an instrument for measuring verbal discourse, was used by Pickford (1988) and Miller (1989), to discover whether professors were accomplishing that which Fischer and Grant suggested. The researchers found that the cognitive level of teaching centered predominantly at the comprehension level; only partially accomplishing the first of the two purposes suggested by Fischer and Grant (1983).

Cognitive Levels of Tests, Quizzes and Assignments

Miller (1989) reported that the cognitive level of performance expected by instructors on tests and quizzes was comparable to the instructor's cognitive level of discourse. Pickford (1988) found that as the cognitive level of tests and assignments increased, students' cognitive level of achievement appeared to increase. This phenomenon could be

partially explained by previous research which suggested that students concentrated on learning whatever they thought would be on the test (Cross, 1988). Pickford (1988) agreed, stating, students assessed the cognitive levels required by tests and assignments and adjusted learning to concentrate on the emphasized levels. Thus, students paid greater attention if they believed the material would be on the exam.

It seems then, that professors would write examinations which would promote higher order thinking among students. Milton (1982) reported that this was not the case. Milton found that 95% of all items surveyed were at the recall level. Cross and Angelo (1988) reported that teacher-made measures concentrated at lower intellectual levels.

The end result of lower level testing was stated by Skinner (1968) who wrote:

Certainly few students could pass their final examinations even a year or two after leaving school or college. What has been learned of permanent value must therefore not be the facts or principles covered by examinations...(p. 89).

This is an interesting statement since researchers have suggested that assignments reportedly challenged students at higher levels of cognition to a greater extent than tests, quizzes (Newcomb and Trefz, 1987; Pickford, 1988; Miller,

1989), or professor discourse (Pickford, 1988; Miller, 1989). McKeachie (1980) contended that what students did outside of the classroom was critical and that assignments were a means of accomplishing outside mental activity.

Professors' Aspiration to Teach at Higher Cognitive Levels

Describing each of the previously listed variables will lead to further understanding of professor characteristics which contribute to higher cognitive levels of instruction. A real key, though, to achieving higher cognitive level instruction may be the aspiration of the professors to reach higher cognitive levels of instruction.

Since previous research on the extent to which professors aspire to teach at higher cognitive levels is non-existent, this author intends to build a case for examining professors' aspiration to teach at higher cognitive levels using two prevalent practices in education - development of instructional objectives, and teacher expectations.

Developing instructional objectives is essential to the success of the unit to be taught (Newcomb et al. 1986). The value of developing instructional objectives lies in the thinking that has to be done by the teacher prior to teaching the unit. The teacher is forced to make definite decisions about desired student outcomes. Just as developing

instructional objectives forces the professor to formulate decisions regarding student outcomes, thinking about the aspired cognitive level of instruction could influence that which is achieved by professors regarding cognitive level of instruction.

Along with the value of developing instructional objectives, there is value in realizing cognitive expectations. As discussed earlier in this chapter, expectations play a powerful role in student outcomes (Rosenthal and Jacobson, 1968). It seems logical that the level of cognition to which the professors aspire to teach and expectations for students to learn across the levels of cognition go hand-in-hand.

If the professor's expectation of students to perform at higher cognitive levels influences student outcomes, then it is likely that extent to which the professor aspires to teach at the higher cognitive levels will affect professor performance. Therefore, examining the level of cognition to which professors aspire in their teaching will be a major variable in this study.

Attitude Toward Teaching at Higher Cognitive Levels

Based on previous research, it is likely that discrepancies may exist between aspired level of cognitive

instruction and actual cognitive level of instruction (Newcomb and Trefz, 1987). An important component of this study will be to determine the attitude of professors toward teaching at higher cognitive levels.

After interviewing faculty participants, Newcomb and Trefz (1987) concluded that faculty members involved in their study felt their cognitive level of instruction was similar to what they had perceived. However, 38% were dissatisfied with the cognitive level of their instruction. They felt too much lower level instruction was dominating their courses. When asked if professors would welcome changes in their tests and assignments, 86% indicated a desire to change to higher level testing. This study will replicate portions of the Newcomb and Trefz study to examine professors' attitudes toward teaching at higher levels of cognition.

Faculty Preference for Inservice Topics and Formats

A study by Love and Yoder (1989) revealed that 99% of the faculty studied agreed that they should be reinforcing the teaching of critical thinking skills and should be designing such learning opportunities for students. Yet, as indicated earlier, several researchers have found little indication that higher cognitive levels are being reached in classrooms. Newcomb and Trefz (1987) reported that

professors were teaching at low levels of cognition, but also reported that 86% of the professors in the study desired to change their teaching to incorporate more higher level activities. This study will assess the requests for enrichment activities by professors who seek to teach at higher levels of cognition.

Summary of Variables

The first variable to be measured in this study will be the aspiration of professors to teach at higher cognitive levels. It seems that just as expectations play a major role in student outcomes, the aspiration of professors to teach at higher cognitive levels could be a major factor in the cognitive level of teaching reached by the professor in the classroom. Thus this variable could be an important contributor.

Logically it would seem that cognitive level of instruction, including level of tests, quizzes and assignments, would contribute the most powerful influence on student cognitive levels. After all, the student is exposed to the professor on at least a weekly basis and is confronted with outside assignments, preparation and study time for an even greater number of hours during the week. Studying this variable could be valuable in providing knowledge regarding

discrepancy or lack of discrepancy between cognitive level of discourse and cognitive level of tests, quizzes and assignments.

A real key, though to what can happen in the future, may depend upon the attitude professors possess toward teaching at higher levels of cognition. Finally this study will examine the needs of those professors who expressed a desire to incorporate higher cognitive level teaching into their classrooms. Each of these variables could prove to be worthy of investigation.

Summary

If in fact a goal in education is to teach students to think beyond memorization, Bloom's Taxonomy (1956) offers a classification system for educators to use as a guideline for accomplishing higher cognitive level instruction. Although the Taxonomy has been faulted by some educators and researchers, it still offers a sound and reliable basis for accomplishing classification of higher order thinking skills.

Students need to possess intellectual abilities and skills for everyday living. Need for intellectual abilities and skills has been a prevalent theme in the educational literature for many years. The task has met with numerous barriers, but even with all the interference, professors must

continue to strive to meet the challenge of providing students with opportunities to practice and develop thinking skills.

Although numerous factors have been suggested to assist students in reaching higher order thinking, this study will focus on four: cognitive level of instruction (including discourse, cognitive level of tests, quizzes and assignments), professors' aspiration to teach at higher cognitive levels, attitude toward teaching at higher cognitive levels, and needs of faculty who seek to teach at higher cognitive levels.

Each variable holds within it an opportunity to discover new knowledge concerning professors' cognitive levels of teaching. Each variable also contains potential for contributing to knowledge by further explaining variables examined in previous studies. The chosen variables are studied in hopes of benefitting students by preparing professors to equip students with a most valuable life-long learning skill--the ability to think.

CHAPTER III

METHODOLOGY

Introduction

The purpose of this study was to describe the aspired cognitive level of instruction and assessed cognitive level of instruction and determine their relationship to attitude toward teaching at higher cognitive levels among selected faculty members in the College of Agriculture at The Ohio State University. This study also sought to discover preferences for inservice topics and formats designed to assist professors in reaching higher cognitive levels of instruction.

Research Design

This research was descriptive - correlational in nature. Four instruments were utilized to present a detailed explanation of each variable of interest and to answer the following research questions:

1. What are the characteristics of faculty members in the College of Agriculture at The Ohio State University who participated in this study in terms of:

- a. general demographics
 - course level taught
 - subject matter taught
 - b. personal demographics
 - age
 - rank
 - c. teaching demographics
 - years of university teaching experience
 - percent appointment from general funds budget
 - number of courses taught per year
 - amount of time before class devoted to preparing for the class session
 - tenure status
 - d. extent of familiarity with levels of cognition
 - number of cognition workshops attended
 - extent of prior involvement in cognition studies
2. At what level of cognition do participants aspire to teach with respect to in-class discourse, written test items, quizzes and assignments?
 3. At what level of cognition are participants actually teaching as determined by assessment of tests, quizzes and assignments, and assessment of in-class discourse as measured by the Florida Taxonomy of Cognitive Behavior?
 4. What is the relationship between cognitive level of instruction to which participants aspire and actual cognitive level of instruction?
 5. Among participants, what is their attitude toward teaching at higher cognitive levels?
 6. What is the magnitude of the discrepancy between aspired cognitive level of instruction and actual cognitive level of instruction?
 7. What is the relationship between aspired cognitive level of instruction and attitude toward teaching at higher cognitive levels?
 8. What is the relationship between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels?

9. What is the relationship between demographic information collected and attitude toward teaching at higher cognitive levels?

10. What inservice topics and inservice formats are requested by participants to assist them in increasing their cognitive level of instruction?

Population and Sample

The target population for this study was 213 faculty members in the College of Agriculture at The Ohio State University. The accessible population was faculty members in the College of Agriculture at The Ohio State University, Columbus campus, who had a teaching appointment on the general funds budget and who were teaching at least one undergraduate course during Autumn Quarter (September 19, 1990 - November 30, 1990).

Based on the time available to the researcher (approximately 200 hours: 20 hours per week times 10 weeks) and the estimated time requirement per professor (20 hours per professor - see Appendix K for approximations), 10 professors were selected for this sample. The professors represented each of five faculty constituent groups (College of Agriculture Faculty Council Bylaws, 1989, p. 7) representing departments in the College of Agriculture. The faculty constituent groups were as follows: Engineering and Food Sciences (including Agricultural Engineering and Food Science and Technology), Animal Sciences (including Animal Science, Dairy Science and Poultry Science), Social Sciences

(including Agricultural Economics and Rural Sociology, and Agricultural Education), Plant Sciences (including Agronomy, Entomology, Horticulture, and Plant Pathology), and The School of Natural Resources.

Two faculty members were selected from each constituent group. From Engineering and Food Sciences participants were selected from the Department of Food Science and Technology and the Department of Agricultural Engineering. Those selected from Animal Sciences included a participant from the Department of Animal Science and one from the Department of Poultry Science. The Social Sciences constituent group was represented by a faculty member from the Department of Agricultural Economics and Rural Sociology and one from the Department of Agricultural Education. Plant Sciences were represented by a participant from the Department of Agronomy and the Department of Horticulture. Finally, Natural Resources was represented by two participants from The School of Natural Resources.

Participants who were known by the investigators to be good teachers as indicated by student evaluations, exit interviews with students, and discussions with department chairs, and who were interested in improving their instruction, as witnessed by attendance at teaching forums and workshops, were selected to participate in the study.

Instrumentation

Letter of Invitation

During the week of August 13, 1990, selected professors received letters of invitation to participate in the study (see Appendix A for all correspondence). The letter explained the value of the study, the approximate time commitment from each professor, and the rewards of participation. The researcher telephoned all professors to encourage their participation, answer their questions and address their concerns.

Collecting Demographic Information

The researcher developed a two-part instrument to collect demographic information about the professors in the study. Part one was designed to be completed by the professor while part two consisted of information which could be obtained from university records. Demographic information of interest to the researcher included characteristics of the professors which could possibly explain the level of cognition at which they taught. See Appendix B for the instrument.

Measuring Professors' Aspiration to Teach at
Higher Cognitive Levels

Development

An instrument was designed by the researcher to collect data regarding the extent to which professors aspire to teach at higher cognitive levels. The researcher, based on previous research (Newcomb and Trefz, 1987; Pickford, 1988; Miller, 1989) determined the information that needed to be collected. For example, Pickford (1988), and Miller (1989), had studied student variables extensively, but had not concentrated on professor variables. It seemed appropriate at this point in the programmatic study of levels of cognition to examine thoroughly the professor variables, one such variable being "aspire to teach at higher cognitive levels."

Since most professors were unfamiliar with Bloom's Taxonomy (1956), the theoretical basis for this study, a lesson was developed to succinctly explain the levels of cognition. See Appendix C for an example of the lesson. To avoid biasing the participants in the study, a research assistant was trained to present the lesson plan and to record the aspired levels of cognition on the "aspiration" instrument. The research assistant was also trained to administer the demographic instrument.

Once the research assistant was comfortable that the professors had acquired a common framework from which to analyze their cognitive level of teaching, the participants were asked to express the cognitive level of instruction to which they aspired for their course. Thus, the instrument designed for gathering the necessary data required the participant to record, in percentages of 100, the level to which they aspired to speak, write test items, quizzes, and assignments

Reliability

Since this instrument was a self-report type scale, where each item measured a variable "percentage at each level", a test/retest procedure was utilized to collect reliability of the instrument. The researcher was not attempting to find internal consistency, but was trying to discover if the same information could be collected on more than one sitting. It was determined before the study that 70% agreement was needed on each item.

The instrument was mailed on August 17, 1990, and requested for return by campus mail within the week, to 25 professors in the pilot test. The number of professors selected for the pilot test was based upon recommendations from Dr. Emmalou Norland, Associate Professor at The Ohio State University who teaches instrumentation and data

collection. She stated that 15-30 subjects were appropriate for a pilot test. Twenty-five faculty members from several disciplines in the College of Agriculture who would not be included in the actual study constituted the members of the pilot study.

The instrument for re-test was mailed again one week after collection of the first instrument and collected within the week. One week was selected as the time interval between the measures based upon recommendations from Dr. Emmalou Norland, Associate Professor at The Ohio State University who teaches instrumentation and data collection. She stated that "one to three weeks" was an appropriate interval for the test/re-test.

The data were examined. The pilot test revealed that items ranged from no agreement to 100% agreement. Thus, it was revealed that reliability must be strengthened. The following methodology was pilot tested on two faculty members, and employed in the study. Participants were asked to place one to ten chips on a posterboard drawn into quadrants, labeled remembering, processing, creating, and evaluating; the four levels of cognition in the Newcomb & Trefz model used in this study. The cognitive level at which they hoped to speak, write test items, quizzes, and assignments was then recorded by the research assistant as a percentage of one hundred. See Appendix D for an example of

the instrument and the materials designed to measure aspired level of instruction.

Validity

Dr. L. H. Newcomb and Dr. Charles Miller were two of the experts who served on the panel of experts to validate the instrument. These researchers had previously studied levels of cognition in the College of Agriculture at The Ohio State University. They examined the lesson plan. The other member of the panel was Dr. Emmalou Norland, an expert in instrumentation. The panel of experts concluded that the instrument and method would yield a valid measure of aspired cognitive level of instruction.

Measuring Assessed Cognitive Level of Instruction

Discourse

The Florida Taxonomy of Cognitive Behavior (FTCB, Webb, 1970; Brown, Ober, Soar and Webb, 1966), based on Bloom's Taxonomy (Bloom, 1956), identifies and quantifies the cognitive levels of student and teacher classroom behavior (Newcomb & Straquadine, 1987). In this study, however, the FTCB was used to measure teacher classroom behavior only.

The FTCB is used to measure the presence of each cognitive level within the observation period, and determines the extent to which the emphasis is on acquiring information

versus using cognitive processes (Webb, 1970). This study utilized the Florida Taxonomy of Cognitive Behavior to measure the verbal discourse aspect of the cognitive level of instruction.

While the development of the FTCB was based upon Bloom's Taxonomy, the two are not identical (Miller, 1989). Miller (1989) describes the differences between the two as follows: The FTCB recognizes seven major levels of cognition rather than six as does Bloom et al. (1956). In the FTCB, the areas of Translation and Interpretation encompass Bloom et al.'s level termed Comprehension. The FTCB also recognizes aspects of the Knowledge level of cognition, but considers them to be equivalent. The Application, Analysis, Synthesis and Evaluation levels are similar in both taxonomies. Table 2 presents a comparison of the levels of cognition identified in Bloom's Taxonomy and those used in the Florida Taxonomy of Cognitive Behavior.

Table 2

Comparison of Bloom's Taxonomy and The Florida Taxonomy of Cognitive Behavior

Bloom's Taxonomy	Florida Taxonomy of Cognitive Behavior
Knowledge	Knowledge
Comprehension	Translation
	Interpretation
Application	Application
Analysis	Analysis
Synthesis	Synthesis
Evaluation	Evaluation

Within each of the levels of cognition (knowledge, comprehension, application, analysis, synthesis, evaluation), Bloom et al. identified specific types or categories of behavior that were indicative of that level. Miller (1989), explained the categorical levels in the following way: The FTCB includes 55 such categories. Approximately one-third of these 55 categories are indicators of the knowledge level of cognition and are classified under the areas of knowledge of specifics, knowledge of ways and means of dealing with specifics, and knowledge of universals and abstracts.

The Translation level includes six categories of behavior that indicate the use of knowledge by restating facts in a different form or by giving examples. The Interpretation level also includes six categories. This level focuses upon thought which is indicative of an understanding of relationships (i.e. giving reasons).

The remaining three levels of the FTCB are Analysis, Synthesis, and Evaluation. They include eleven, nine, and two categories of behavior respectively and these categories are comparable to those specified by Bloom et al.. (1956; cited in Miller, 1989). Appendix I shows the FTCB.

Reliability.

Reliability of the FTCB is dependent upon the raters' utilization of the instrument (Pickford, 1988). In this study, a single rater observed all but one participant; that participant was observed by a research assistant. Both raters received the following training: The raters received training from a researcher with extensive experience in the use of the FTCB. Training involved an explanation of the use of the instrument followed by practice using videotaped teaching episodes. Initial practice sessions were conducted with the trainer present to provide guidance in the use of the instrument. Later sessions involved independent practice by this study's rater.

Following training, intra-rater reliability (a measure of rater consistency in the use of the instrument) was assessed by using observations of two video tapes of teaching by Plimpton (1981) and Golden (1981). Spearman Rho Coefficients of Correlation (ρ) were calculated using the SPSSx/PC+ statistical program. The intra-rater reliability was $\rho = .98$ for the Plimpton tape and $\rho = .99$ for the Golden tape. The inter-rater reliability was established using audio tapes on file from a previous study. The reliability was $\rho = .97$ for the Schmidt tape and $\rho = .98$ for the Mangino tape.

Validity.

The validity of the FTCB is based upon its direct derivation from Bloom's Taxonomy (Miller, 1989). Consequently, it is argued that the FTCB can be considered valid in light of the support generally given to Bloom's Taxonomy as a means of identifying behaviors in the various levels of cognition (Miller, 1989).

Tests, Quizzes and Assignments

Development.

The researcher employed measurement strategies which were successfully used by previous researchers (Newcomb & Trefz, 1987; Pickford, 1988; Miller, 1989) in assessing the

cognitive level of tests, quizzes and assignments. Previous researchers used Bloom's Taxonomy (1956) and the Florida Taxonomy of Cognitive Behavior (Webb, 1970) to accurately assess tests, quizzes and assignments. Each item was read, analyzed for the mental process it stirred within the student and then matched to the proper level in Bloom's Taxonomy.

Reliability.

Inter-rater reliability was established between this researcher and the researchers of the previous studies so that data could be interpreted across studies. Inter-rater reliability was established for written materials by using classifications of tests, quizzes and assignments on file from previous studies, and by communicating with the previous researchers. The researcher re-assessed tests on file from a previous study, correlated the number at each level from the two assessments. Reliability was established on the Forster test at $p = .97$.

Intra-rater reliability was established by re-assessing the classification of items on a test from a previous study. The Erven test, 1987 assessed one week apart, established a reliability coefficient of $p = .98$.

Measuring Attitude Toward Teaching
at Higher Cognitive Levels

Development

Professors' attitude toward teaching at higher cognitive levels was assessed using a six-point Likert scale developed by the researcher. The Likert scale used the following descriptors: "1" = "strongly disagree", "2" = "moderately disagree", "3" = "slightly disagree", "4" = "slightly agree", "5" = "moderately agree", and "6" = "strongly agree". A copy of the instrument can be found in Appendix E.

Seventy-four items were written for the initial review by the researchers. During the initial review, questions used to determine acceptance/non-acceptance of an item included: "If I answer this question by circling '6', what does that tell me about my attitude toward teaching at higher cognitive levels?", and "Is this item measuring my attitude toward teaching at higher cognitive levels or my attitude toward something or someone else?". Based upon the answers to questions, items such as "Peer reviews encourage me to improve my cognitive level of teaching", "I am confused about teaching at higher levels of cognition", and "I observed student growth across the levels of cognition during the quarter" were eliminated. Thirty-two items were deleted. Thus a 45 item questionnaire was presented to the panel of

experts for review. The panel added five items. Thus, a 50 item questionnaire was presented to the professors in the pilot study.

Reliability

Reliability was established using a pilot test of 25 faculty members in the College of Agriculture who were not participants in the study. After two mailings, 17 professors had returned their instruments for a 68% return rate.

The data were analyzed using SPSSx/PC+. Cronbach's alpha was selected as the reliability measure since this instrument was a summated scale which required a test for internal consistency. Kuder-Richardson 21 was another choice but was not selected because it does not generate a correlation matrix for reliability of each item. Negative items were reverse scored.

Cronbach's alpha for the 50 item questionnaire was established at $r = .83$. There were no out-lying coefficients in the item analysis; the lowest coefficient was $r = .81$ and the highest was $r = .84$. Thus, the questionnaire presented to the professors for the study contained 50 items and a Cronbach's alpha of $r = .83$.

Cronbach's alpha was calculated using the actual data from the participants in the study. For the 10 participants completing the 50 item questionnaire reliability was

established at $r = .86$. The lowest coefficient was $r = .84$ and the highest was $r = .87$.

Validity

Dr. L. H. Newcomb, Ms. Marilyn Trefz, and Dr. Charles Miller served as the panel of experts to validate the instrument. These researchers had previously studied levels of cognition in the College of Agriculture at The Ohio State University. They were asked to examine the instrument for content validity, construct validity, and item clarity. The instrument was thoroughly examined. Suggestions implemented by the panel of experts included:

1. Change the original wording of "actual" cognitive level of teaching to "assessed" cognitive level of teaching.
2. Add "totals" to each of the cognitive levels rather than just totals for the overall cognitive level of teaching.
3. Addition of five items to the pilot test instrument such as, "The higher the level of the course, the higher the level of cognition at which the course should be taught".

Preference for Inservice Topics and Formats for Teaching at Higher Cognitive Levels

Development

Professors' preferences for inservice topics and formats regarding higher cognitive level instruction were

found using an instrument developed by the researcher. The instrument was intended to discover topics which could be used to bring faculty to a higher level of awareness regarding cognitive levels of instruction. The researcher also sought implementation strategies to accomplish higher level instruction among professors in the college.

To accomplish these goals, two scales were used. The first scale was a 10 item, five point Likert scale designed to find the most favorable inservice topics. The topics were established by referring to previous studies and by brainstorming with researchers from previous cognition studies. The Likert scale used the following descriptors: "1" = "very favorable", "2" = "fairly favorable", "3" = "don't know", "4" = "fairly unfavorable", and "5" = "very unfavorable". A copy of the instrument can be found in Appendix F.

Preferred inservice formats were collected using part two of the instrument. A list of six inservice formats were designed to be rank ordered. Space was allowed for write-in comments.

Reliability

Reliability was established using data from the pilot test of 25 faculty members in the College of Agriculture who were not participants in the study. After two mailings, 17

professors had returned the instruments for a 68% return rate. The data were analyzed using SPSSx/PC+. Cronbach's alpha for the Likert scale items was established at $r = .86$; the lowest coefficient was $r = .81$ and the highest coefficient was $r = .86$.

Validity

Dr. L. H. Newcomb, Dr. Charles Miller, and Dr. N. L. McCaslin served as the experts to validate the instrument. Two of the researchers had previously studied levels of cognition in the College of Agriculture at The Ohio State University. The other was an expert in the area of needs assessment. They were asked to examine the instrument for content validity and item clarity.

Data Collection

Measuring Professors' Aspiration

to Teach at Higher Cognitive Levels

The cognitive level to which professors aspired to teach was determined through personal interviews between the research assistant and the participant. The data collection was preceded by instruction or review (whichever was appropriate to the individual professor) of Bloom's (1956) levels of cognition. The professors were also introduced to

the Newcomb-Trefz model since this model represents Bloom's Taxonomy in a fashion that is more readily grasped.

The Newcomb-Trefz model uses four major categories (remembering, processing, creating, and evaluating) rather than the six categories of Bloom's Taxonomy or the seven categories of the FTCB. The major difference is that in the Newcomb-Trefz model, translation, interpretation, application, and analysis are combined into "processing" (Pickford, 1988). Table 3 visually portrays a comparison of the three models.

Table 3

A Comparison of Bloom's Taxonomy, The Florida Taxonomy of Cognitive Behavior and The Newcomb-Trefz Model

Bloom's Taxonomy	Florida Taxonomy of Cognitive Behavior	Newcomb- Trefz Model
Knowledge	Knowledge	Remembering
Comprehension	Translation	Processing
	Interpretation	
Application	Application	
Analysis	Analysis	
Synthesis	Synthesis	Creating
Evaluation	Evaluation	Evaluating

This explanation of the levels of cognition and the models used to portray the levels was necessary to establish a common framework for all participants in the study. Following a brief explanation of the models involved in classifying the cognitive level of instruction, the professors were asked to report the cognitive level to which they aspired to teach.

The participants did this by placing one to ten chips on one of four quadrants labeled remembering, processing, creating and evaluating. The process was repeated for discourse, written test items, quizzes, and assignments. Using the instrument "Aspired Cognitive Level of Instruction" developed by the researcher, the research assistant recorded the number of chips on each quadrant as a percentage of one hundred. These data were collected one week prior to the beginning of Autumn Quarter, 1990.

Assessing Actual Cognitive Level of Instruction Discourse

Using the Florida Taxonomy of Cognitive Behavior (FTCB), professors' cognitive level of teaching was observed and measured three times during the 10 week Autumn Quarter, 1990. The professors were observed during the second week of the quarter, the fifth week of the quarter and the eighth

week of the quarter. The researcher planned to observe each professor as early in the quarter as possible, but it seemed appropriate to avoid the first week of classes since during the first week good teaching is often interrupted by numerous "housekeeping chores".

The researcher also planned to observe the professors as near to the end of the quarter as possible, but during the last week of classes professors frequently plan reviews and tests. Thus, the eighth week was targeted for the third observation and the second observation was placed in the middle of the first and third observations.

During each observation the researcher was present in the room to audio tape the session, to note any unusual circumstances, and to collect any handouts or gather other pertinent information which might influence the cognitive level of teaching. Within twenty-four hours the researcher listened to the tape-recorded session and assessed it using the FTCB.

In using the FTCB, the researcher used six minute observation periods. Each time a cognitive behavior was observed it was categorized by making a check mark in the appropriate box for the given time period. If the observed behavior represented more than one category, all categories that were involved were checked. In any given observation period each category was checked only once, even if more than

one observation of that cognitive behavior had been observed. Appendix J is a copy of the time scale and note sheet used in the observation period.

Tests, Quizzes and Assignments

The researcher began collecting tests, quizzes and assignments as they were prepared by the participant. The researcher assessed each item on each test, quiz, and assignment as they were collected. At the professor's convenience, the researcher met with the professor to review the assessments and to confer as to the classification of each item.

Measuring Attitude Toward Teaching at Higher Cognitive Levels

The instrument, "Professor's Attitude Toward Teaching at Higher Cognitive Levels" designed by the researcher, was delivered with an addressed campus envelope during the first meeting between the research assistant and the participant. The participant was asked to return the instrument within one week.

Collecting Faculty Preference
for Inservice Topics and Formats

Inservice topics and formats regarding teaching at higher cognitive levels were collected at the completion of the study. Participants chose the week most convenient for them. For seven participants this was the tenth week of the quarter. For two participants this step took place during finals week of Autumn Quarter. For one participant the data was collected three weeks following Autumn Quarter. The researcher administered and collected the instrument during the final meeting with the professor.

Data Analysis

The Statistical Package for the Social Sciences (SPSSx/PC+) computer package was used to analyze the data since this package is especially designed to process data collected for social and behavioral research. The SPSS package was accessed using the facilities available at The Ohio State University.

Responses were entered into the computer at the end of the collection period. For each variable in the study, measures of central tendency and frequency distributions were generated and then used to describe the sample in the study. Pearson Product Moment Coefficients of Correlation were

calculated between aspired cognitive level of instruction and:

- assessed cognitive level of instruction
- attitude toward teaching at higher cognitive levels
- demographic information

Pearson Product Moment Coefficients of Correlation were calculated between assessed cognitive level of instruction and:

- aspired cognitive level of instruction
- attitude toward teaching at higher cognitive levels
- demographic information

Each professor in the study was considered as a case and was coded using a two-digit code from 01 - 10.

Analyzing Professors' Aspiration to

Teach at Higher Cognitive Levels

The aspired cognitive level of teaching was analyzed as four categories viz. discourse, written test items, quizzes and assignments. Each category was examined at four levels of cognition, remembering, processing, creating, and evaluating.

Analyzing Cognitive Level of Discourse

Cognitive level of discourse was calculated using the process employed by Pickford (1988). For each class observation a calculation was made of the total number of times that cognitive behaviors occurred during each observation period for each of the 55 categories within the seven levels of the FTCB. The three observations were summed for total frequencies at each level. Percentages for each level were calculated for each class observation by dividing the frequencies at each level by the total number of frequencies.

Analyzing Tests, Quizzes and Assignments

Tests, quizzes and assignments were analyzed using a process developed by Pickford (1988). For tests, quizzes, and assignments, separately, the total number of items at each level was divided by the total number of items to obtain a percentage of items at each level of cognition.

Analyzing Attitude Toward Teaching at Higher Cognitive Levels

The Likert scale ratings were summed to yield a score which represented the attitude toward teaching at higher cognitive levels. Since there were 50 items in the

questionnaire, the lowest possible score, if all items were completed was fifty. The highest possible score if all items were completed was three hundred. This score was then correlated with other variables in the study. Sixteen items were stated negatively and thus were reverse scored.

Assessing Faculty Preference for Inservice Topics and Formats

Participants' preferences for inservice topics regarding teaching at higher cognitive levels was assessed by calculating the means and frequencies of the Likert scale items. The highest means were reported as the highest preference for inservice topics.

Preferred inservice formats were determined by summing the rank ordered entires of the participants. Since participants ranked their first choice as one and their last choice as six, the lowest sum was considered the highest preference for an inservice format.

Summary

This study was conducted during Autumn Quarter, 1990, to determine the cognitive level to which professors aspire to teach, the cognitive level at which they taught, and their attitude toward teaching at higher cognitive levels. This research also examined inservice topics and formats preferred

by professors regarding teaching at higher cognitive levels. Participants were purposefully sampled based on their interest in teaching.

Data were collected using four instruments during Autumn Quarter, 1990 and were analyzed at the Ohio State University using the Statistical Package for Social Sciences. Descriptive statistics were employed.

CHAPTER IV

FINDINGS

Introduction

The purpose of this study was to describe the aspired cognitive level of instruction and assessed cognitive level of instruction and determine their relationship to attitude toward teaching at higher cognitive levels among selected faculty members in the College of Agriculture at The Ohio State University. This study also sought to discover preferences for inservice topics and formats designed to assist professors in reaching higher cognitive levels of instruction. The major variables of interest were aspired cognitive level of instruction, assessed cognitive level of instruction, and attitude toward teaching at higher cognitive levels.

This chapter presents the findings of the study which was designed to answer the following research questions:

1. What are the characteristics of faculty members in the College of Agriculture at The Ohio State University who participated in this study in terms of:
 - a. general demographics
 - course level taught
 - subject matter taught

- b. personal demographics
 - age
 - rank
 - c. teaching demographics
 - years of university teaching experience
 - percent appointment from general funds budget
 - number of courses taught per year
 - amount of time before class devoted to preparing for the class session
 - tenure status
 - d. extent of familiarity with levels of cognition
 - number of cognition workshops attended
 - extent of prior involvement in cognition studies
2. At what level of cognition do participants aspire to teach with respect to in-class discourse, written test items, quizzes and assignments?
 3. At what level of cognition are participants actually teaching as determined by assessment of tests, quizzes and assignments, and assessment of in-class discourse as measured by the Florida Taxonomy of Cognitive Behavior?
 4. What is the relationship between cognitive level of instruction to which participants aspire and actual cognitive level of instruction?
 5. Among participants, what is their attitude toward teaching at higher cognitive levels?
 6. What is the magnitude of the discrepancy between aspired cognitive level of instruction and actual cognitive level of instruction?
 7. What is the relationship between aspired cognitive level of instruction and attitude toward teaching at higher cognitive levels?
 8. What is the relationship between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels?
 9. What is the relationship between demographic information collected and attitude toward teaching at higher cognitive levels?

10. What inservice topics and inservice formats are requested by participants to assist them in increasing their cognitive level of instruction?

A purposeful sample of ten professors in the College of Agriculture at The Ohio State University constituted the population for this study. Participants who were known by the investigators to be good teachers as indicated by student evaluations, exit interviews with students, and discussions with department chairs, and who were interested in improving their instruction, as witnessed by attendance at teaching forums and workshops, were selected for participation in this study. The findings of this study cannot be generalized beyond the ten participants selected for this study.

The cognitive level to which participants aspired to teach was assessed using an instrument designed by the researcher. Their attitude toward teaching at higher cognitive levels was measured using an attitude scale developed by the researcher. Additionally, the cognitive level of instruction was described using four types of course experiences viz. in-class discourse, written test items, quizzes, and assignments.

Discourse was assessed using the Florida Taxonomy of Cognitive Behavior. Written test items, quizzes and assignments were assessed item by item using guidelines established by Newcomb and Trefz (1987) using Bloom's

Taxonomy (1956). Demographic information was collected using a questionnaire developed by the researcher.

Population Characteristics

The population of this study consisted of ten professors who taught undergraduate courses in the College of Agriculture at The Ohio State University during Autumn Quarter (September 19 - November 30), 1990. The participants represented each of five faculty constituent groups (College of Agriculture Faculty Council Bylaws, 1989, p. 7) in the College of Agriculture. The faculty constituent groups were: Engineering and Food Sciences (including Agricultural Engineering and Food Science and Technology), Animal Sciences (including Animal Science, Dairy Science and Poultry Science), Social Sciences (including Agricultural Economics and Rural Sociology, and Agricultural Education), Plant Sciences (including Agronomy, Entomology, Horticulture, and Plant Pathology), and The School of Natural Resources.

Two faculty members were selected from each constituent group. From Engineering and Food Sciences participants were selected from the Department of Food Science and Technology and the Department of Agricultural Engineering. Those selected from Animal Sciences included a participant from the Department of Animal Science and one from the Department of Poultry Science. The Social Sciences constituent group was

represented by a faculty member from the Department of Agricultural Economics and Rural Sociology and one from the Department of Agricultural Education. Plant Sciences were represented by a participant from the Department of Agronomy and the Department of Horticulture. Finally, Natural Resources was represented by two participants from The School of Natural Resources.

General Demographics

Participants in the sample taught various levels of courses in the undergraduate curriculum. As can be seen in Table 4, participants taught 100 (freshman) level through 500 (senior) level courses. More specifically, 30% of the participants in the study (three individuals) taught 400 level courses while one participant taught a 500 level course. Two participants taught 100, 200 or 300 level courses.

Table 4

Departmental Listing of Participants by Course Level Taught

100 Level	200 Level	300 Level	400 Level	500 Level
Food Science and Technology	Agricultural Mech and Systems	Agricultural Economics	Agronomy	Agricultural Education
Animal Science	Natural Resources	Natural Resources	Animal Science	
			Horticulture	

Personal Demographics

Personal demographic information collected from participants in the study included age and rank. As shown in Table 5, participants in this study ranged from 35 - 63 years of age (mean = 48, modes = 35 and 44).

Table 5

Age of Participants

Statistic	Years
Range	35 - 63
Mode	35* and 44*
Mean	48

Note. n = 10,

*bimodal distribution with frequency of 2

Three faculty members were assistant professors, two were associate professors and five were full professors. Data for rank of participants is shown in Table 6.

Table 6

Rank of Participants

<u>Rank</u>	<u>Number</u>
Assistant Professor	3
Associate Professor	2
Full Professor	5
Total	10

Teaching Demographics

Teaching demographics collected for each participant in the study included years of university teaching experience, percentage of the participant's appointment funded from the general funds budget, approximate number of courses taught per year, amount of time before class devoted to preparing for the class session, and tenure status. Table 7 reveals the range, mode, and mean of years of teaching experience, percent of the participant's appointment funded from the general funds budget, and number of courses taught per year for the participants. Years of university teaching

experience ranged from 2 - 39 years (mean = 14 years, mode = 16 years). Appointments from the general funds budget ranged from 50% - 100% (mean = 72%, mode = 50%). Participants taught as few as three courses per year and as many as seven (mean = 4.4, mode = 3).

Table 7

Teaching Demographics of Participants

<u>Teaching demographics</u>	<u>Range</u>	<u>Mode</u>	<u>Mean</u>
Years of university teaching experience	2 - 39	16	14.2
Percent appointment from general funds budget	50 - 100	50	72
Number of courses taught per year	3 - 7	3	4.4

Note. n = 10

As can be seen in Table 8, one-half of the participants in this study (5) devoted one hour before class preparing for the class session. One faculty member spent one-half hour preparing for class while four participants devoted one and one-half hours before class preparing for the class session.

Table 8

Time Before Class Devoted to
Preparing to Teach the Class
Session

<u>Time</u>	<u>Participants</u>
30 minutes	1
1 hour	5
1 1/2 hours	4
Total	10

The faculty in this study were asked if they were tenured. Eighty percent of the participants in this study were tenured (see Table 9).

Table 9

Tenure Status of Participants

<u>Status</u>	<u>Number</u>
Tenured	8
Not tenured	2
Total	10

Extent of Familiarity of the Participants
with Levels of Cognition

Familiarity with cognitive levels of instruction among the participants in the study was determined by asking them to report the number of cognition workshops previously attended and to estimate the number of cognition research projects, provided by the Department of Agricultural Education, in which they had participated previous to this study. Table 10 displays the number of cognition workshops previously attended by the participants. Of the ten participants in the study, one had attended no cognition workshops; two had attended six cognition workshops. Faculty members had participated in an average of nearly three cognition workshops per faculty member prior to involvement in this study.

Table 10

Cognition Workshops Attended
by Participants

<u>Workshops</u>	<u>Participants</u>
0	1
1 - 2	5
3 - 4	2
5 - 6	2
<u>Total</u>	<u>10</u>

Note. Mean = 2.7

Table 11 reveals the previous number of cognition research projects in which the faculty in the study had participated. Eight faculty members had participated in no previous cognition research studies while two faculty members had participated in two cognition research studies.

Table 11
Participation in Previous
Cognition Research

<u>Projects</u>	<u>Participants</u>
0	8
1	0
2	2
<u>Total</u>	<u>10</u>

Aspired Cognitive Level of Instruction

The level of cognition to which participants aspired to teach was collected using four aspects of instruction viz. in-class discourse, written test items, quizzes, and assignments. Measures were collected by cognitive level, i.e. remembering, processing, creating and evaluating. The data are presented in Tables 12 - 15.

Cognitive Level to Which Participants Aspire **for Their Discourse**

In Table 12 it can be seen that five participants aspired to have 40% of their discourse at the remembering level of cognition; one aspired to have 80% of the discourse at the remembering level (mean = 39%). Four faculty members

wanted 30% of their discourse at the processing level while one aspired for 50% processing (mean = 32%).

Where discourse at the creating level was concerned, of the ten participants in this study, three participants sought no discourse at the creating level while three aspired to have 20% of their discourse at the creating level (mean = 14%). Four faculty members hoped for 10% (2) and 30% (2) creating level discourse during teaching. Six participants aspired to have 10% - 20% of their discourse at the evaluating level while two sought no discourse at the evaluating level; two others aspired to have 30% of their discourse at the evaluating level (mean = 15%).

Table 12

Cognitive Level of In-class Discourse to Which Participants
Aspire

Participant	Percent at each level of cognition			
	R	P	C	E
1	60	30	0	10
2	80	10	10	0
3	40	20	20	20
4	10	30	30	30
5	40	50	0	10
6	40	30	20	10
7	40	40	20	0
8	40	30	0	30
9	30	40	10	20
10	10	40	30	20
Mean	39	32	14	15

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

Total number reporting = 10

Cognitive Level to Which Participants Aspire
for Their Written Test Items

As can be seen in Table 13 three participants aspired to write 50% of their test items at the remembering level of cognition while one aspired to write 60% of the test items at the remembering level (mean = 38%). Four participants wanted to write 30% of their test items at the processing level; two hoped for 50% of their test items to be processing level items (mean = 36%).

Four faculty members aspired to have 10% of their test items at the creating level; three sought to write no test items at the creating level (mean = 12%). Eight participants aspired to have 10% - 20% of their test items at the evaluating level and two faculty members wanted either no test items at the evaluating level or 30% at the evaluating level (mean = 14%).

Table 13

Cognitive Level to Which Participants Aspire to Write Test
Items

Participant	Percent at each level of cognition			
	R	P	C	E
1	60	30	0	10
2	40	30	20	10
3	50	30	10	10
4	20	20	30	30
5	30	50	10	10
6	50	30	10	10
7	50	50	0	0
8	40	40	0	20
9	30	40	10	20
10	10	40	30	20
Mean	38	36	12	14

Note. R = Remembering, P = Processing, C = Creating,

E = Evaluating

Total number reporting = 10

Cognitive Level to Which Participants Aspire
to Write Their Quizzes

Table 14 contains data regarding the cognitive level sought by participants for their quizzes. The reader should note that only two faculty used quizzes in their courses. One participant aspired to write 10% of the quiz items at the remembering level and one participant sought to write 70% of the quiz items at the remembering level (mean = 40%); both wanted 30% - 40% at the processing level (mean = 35%). The participants ranged from zero to 30% aspiration for quiz items at the creating level (mean = 15%) and ranged from zero to 20% at the evaluating level (mean = 10%).

Table 14

Cognitive Level to which Participants Aspire to Write Quiz Items

Participant	Percent at each level of cognition			
	R	P	C	E
3	70	30	0	0
10	10	40	30	20
Mean	40	35	15	10

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

Total number reporting = 2. Participants 3 and 10 used quizzes as requirements for their classes.

Cognitive Level to Which Participants Aspire to Write Their Assignments

Caution should be exercised in interpreting Table 15 since only five of the participants used assignments as part of the requirements for their courses. One participant sought to write no assignments at the remembering level while one participant wanted 30% of the assignments to be at the remembering level. Three desired 10% of their assignments to be at the remembering level (mean = 12%). Two participants aspired for 10% of the assignments to be at the processing

level while three ranged from 20% - 40% at the processing level (mean = 22%).

One participant aspired to have 60% creating level assignments; four wanted 20% - 30% of the assignments at the creating level (mean = 32%). Meanwhile, participants ranged from wanting 20% - 50% of their assignments at the evaluating level (mean = 18%).

Table 15

Cognitive Level to Which Participants Aspire to Write Assignments

Participant	Percent at each level of cognition			
	R	P	C	E
3	10	10	30	50
4	0	30	30	40
6	30	20	20	30
9	10	40	20	30
10	10	10	60	20
Mean	12	22	32	34

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

Total number reporting = 5. Participants 3, 4, 6, 9, and 10 used assignments as requirements for their classes.

Assessed Cognitive Level of Instruction

Participant's cognitive level of instruction was assessed using the following four categories of measurement: in-class discourse, written test items, quizzes and assignments. The measures were classified by cognitive level, i.e. remembering, processing, creating, and evaluating. Percentages and means for each category at each level are presented in Tables 16 - 19.

Assessed Cognitive Level of Discourse

The cognitive level of discourse at the remembering level for participants in this study (see Table 16), ranged from 34% - 57% (mean = 42%). Discourse averaged 53% at the processing level with one participant delivering 38% processing level discourse while one participant presented 60% processing level discourse. Creating level discourse ranged from 2% - 9% (mean = 5%). One-half of participants (5) were assessed to have 5% - 6% discourse at the creating level. Evaluating level discourse ranged from 0% - 1% (mean = less than 1%) with one-half (5) presenting zero percent evaluating level discourse.

Table 16

Assessed Cognitive Level of In-class Discourse

Participant	Percent at each level of cognition			
	R	P	C	E
1	51	47	2	0
2	41	54	4	<1
3	38	56	6	0
4	57	38	5	0
5	42	53	6	0
6	43	49	7	1
7	37	54	9	0
8	35	59	5	<1
9	36	56	6	1
10	34	60	4	1
Mean	42	53	5	<1

Note. R = Remembering, P = Processing, C = Creating,

E = Evaluating

Total number reporting = 10.

Assessed Cognitive Level of Written Test Items

Table 17 shows that 0% - 62% (mean = 39%) of the test items were written at the remembering level by participants in this study. One-half of the participants (5) wrote between 31% and 38% of the test items at the remembering

level. From 0% - 57% (mean = 41%) of the test items were written at the processing level. Four participants wrote 40% - 47% of the test items at the processing level.

One participant wrote 100% of the test items at the creating level; two wrote no test items at the creating level. Six participants wrote less than five percent of the test items at the creating level. Evaluating level test items ranged from 0% - 19% (mean = 7%). Six participants wrote 5% or fewer of their test items at the evaluating level.

Table 17

Assessed Cognitive Level Of Tests

Participant	Percent at each level of cognition			
	R	P	C	E
1	38	57	1	4
2	40	53	2	5
3	58	40	0	3
4	0	0	100	0
5	62	35	3	0
6	38	47	5	10
7	31	57	0	13
8	33	46	2	19
9	54	36	6	5
10	37	43	7	11
Mean	39	41	13	7

Note. R = Remembering, P = Processing, C = Creating,

E = Evaluating

Total number reporting = 10.

Assessed Cognitive Level of Quiz Items

The data for participants' quizzes must be examined with the knowledge that only two participants used quizzes in their courses. From 0% - 57% (mean = 28%) of the quiz items

were at the remembering level of cognition (see Table 18); 39% - 50% (mean = 45%) at the processing level; 3% - 50% (mean = 26%) at the creating level; and 0% - 1% (mean = less than 1%) at the evaluating level. Because of the low number of participants using quizzes, no further analysis of quizzes was completed.

Table 18

Assessed Cognitive Level of Quizzes

Participant	Percent at each level of cognition			
	R	P	C	E
3	57	39	3	1
10	0	50	50	0
Mean	28	45	26	1

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

Total number reporting = 2. Participants 3 and 10 used quizzes as requirements for their classes.

Assessed Cognitive Level of Assignments

Readers need to be aware that only five participants in this study used assignments for their courses. Table 19 reveals that assignments were assessed to range from 0% - 39% (mean = less than 1%) at the remembering level of cognition.

At the processing level, participants' assignments ranged from 0% - 100% (mean = 39%). Creating level assignments ranged from 0% - 100% (mean = 45%) while evaluation level assignments ranged from 0% - 41% (mean = 15%). No other analysis of assignments was completed because of the low number of participants (n = 5) utilizing assignments in their courses.

Table 19

Assessed Cognitive Level of Assignments

Participant	Percent at each level of cognition			
	R	P	C	E
3	0	100	0	0
4	0	17	83	0
6	0	33	34	33
9	4	45	10	41
10	0	0	100	0
Mean	<1	39	45	15

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

Total number reporting = 5. Participants 3, 4, 6, 9, and 10 used assignments as requirements for their classes.

**Discrepancy Between Aspired Cognitive Level of
Instruction and Assessed Cognitive Level of
Instruction**

Participants were asked at the beginning of the study to indicate the cognitive level of instruction to which they aspired to teach as measured in four aspects of instruction--in-class discourse, written test items, quizzes, and assignments. Throughout the study the researcher assessed these measures of instruction across four levels of cognition, i.e. remembering, processing, creating, and evaluating.

Tables 20 and 21 display the scores for the level of cognition to which the participants aspired to teach, scores for actual level at which they taught as determined by the researcher's assessment, and discrepancy scores for discourse and test items written. Discrepancy scores were obtained by subtracting the assessed scores from the aspired scores.

If discrepancy scores of the participants were within five percentage points, positively or negatively, of the aspired scores, the participants were judged to have met their aspired level. Five percentage points, positively or negatively, was selected by the researcher to allow a total spread of ten points; the same interval scale used by the participants to complete the "aspired level" instrument. It seemed impossible to expect the participants to meet the aspired level precisely since a 100 point interval scale was

used, so based on the discrepancy scores of all ten participants, a ten point spread, five points positively or negatively, was selected.

For example, participant number ten aspired to write 40% of the test items at the processing level. Assessment of the participant's test items revealed that 43% of the test items were written at the processing level; the discrepancy score was negative three ($40 - 43 = -3$). Therefore, participant number ten was reported as obtaining the aspired level for testing at the processing level.

Discourse at the remembering level

Table 20 shows that three participants were assessed to have provided more discourse at the remembering level than they had aspired while assessment of level of discourse revealed that two participants had lower percentages of discourse at the remembering level than they had aspired.

Five participants reached the level of discourse at the remembering level to which they had aspired. All five wanted 40% discourse at the remembering level. It should be noted that two participants who were below the aspired level had sought very high percentages of discourse at the remembering level. Of the three who exceeded their aspiration, two had hoped for 10% discourse at the remembering level. Thus, no matter what portion of their discourse the participants

aspired to have at the various levels of cognition, all participants conducted between 34% and 57% discourse at the remembering level. The majority of participants (7) conducted 35% - 45% of their discourse at the remembering level.

Discourse at the processing level

In Table 20 it can be seen that the highest percentage of processing level discourse sought was 50%. Two participants aspired to conduct 10% - 20% of their discourse at the processing level. Discrepancy scores were negative for all participants indicating that percent of discourse at the processing level was assessed to be higher than participants had aspired. One participant achieved eight percent more discourse at the processing level than was originally sought while one participant had 44% more discourse at the processing level than was originally sought. It can be seen that no matter what extent the participants aspired to conduct discourse at the processing level, they conducted between 38% and 61% of their discourse at the processing level.

Discourse at the creating level

One participant aspired to conduct 30% of the discourse at the creating level. Of the three participants who were

considered by the researcher to have obtained their aspired level of discourse at the creating level, none aspired to conduct more than 10% of their discourse at the creating level. One-half of the participants (5) had 5% - 6% of their discourse occurring at the creating level. One should note that no matter how much discourse participants aspired to have at the creating level, no one was found to have 10% or more (see Table 20).

Discourse at the evaluating level

Discourse at the evaluating level is reported in Table 20. One participant was judged by the researcher to have attained the aspired level of discourse, which was zero; the participant reached one percent. No participants had more than one percent of their discourse at the evaluating level. The participants failed to reach the percentage of discourse to which they aspired by as much as 30% with the average discrepancy being 14.5%.

Table 20

Discrepancy Between Aspired Discourse Scores and Assessed
Discourse Scores Across the Levels of Cognition

Case	Levels											
	Percent Remembering			Percent Processing			Percent Creating			Percent Evaluating		
	Asp	Asd	Dsc	Asp	Asd	Dsc	Asp	Asd	Dsc	Asp	Asd	Dsc
1	60	51	9	30	47	-17	0	2	-2	10	0	10
2	80	41	39	10	54	-44	10	4	6	0	1	-1
3	40	38	2	20	56	-36	20	6	14	20	0	20
4	10	57	-47	30	38	-8	30	5	25	30	0	30
5	40	42	-2	50	52	-2	0	6	-6	10	0	10
6	40	43	3	30	49	-19	20	7	13	10	1	9
7	40	37	3	40	54	-14	20	9	11	0	0	0
8	40	35	5	30	59	-29	0	5	-5	30	1	29
9	30	37	7	40	56	-16	10	6	4	20	1	19
10	10	34	-24	40	61	-21	30	4	26	20	1	19
Mean	39	42	-.5	32	53	-21	14	5	8.6	15	<1	14.5

Note. Asp = aspired, Asd = assessed, Dsc = discrepancy

Dsc = Asp - Asd

Testing at the remembering level

One participant aspired to write 10% of the test items at the remembering level (see Table 21), while another aspired to write 60% of the items at the remembering level. One participant was assessed to have written exactly the percentage of test items at the remembering level that was desired. Four participants wrote a higher percentage of test items at the remembering level than was originally sought. With the exception of one participant, who wrote no test items at the remembering level, no matter what percentage of test items participants aspired to write at the remembering level, 30% - 60% of the test items were assessed as remembering level items. The majority of participants (6) wrote 30% - 40% of their test items at the remembering level.

Testing at processing the level

As can be seen in Table 21 all but one participant aspired to have 30% - 50% of their test items written at the processing level. However, the majority of participants (7) wrote 40% - 60% of test items at the processing level. Two participants were judged by the researcher to have attained their aspiration for percent of test items written at the processing level; both had aspired to write 40% of their items at the processing level. Six participants wrote more

items at the processing level than they had aspired. With the exception of one participant, all wrote 35% or more test items at the processing level.

Testing at the creating level

Participants in the study (see Table 21) aspired to write as many as 30% of their test items at the creating level. However, three participants did not aspire to write any creating level test items. One participant wrote 100% of test items at the creating level, while all other participants wrote fewer than 10% of their items at the creating level. Four participants were considered by the researcher to have reached their original aspiration; two wanted zero creating level test items and two hoped for 10% creating level items.

Testing at the evaluating level

Table 21 indicates that one-half of the participants (5) aspired to write 10% of their test items at the evaluating level. However, four participants wrote 10% or more (maximum was 19%) items at the evaluating level of cognition. Three participants were judged to have attained their aspired level while six were below their aspired level. One participant exceeded the original aspiration by 13%; the original aspiration was zero.

Table 21

Discrepancy Between Aspired Scores for Testing and Assessed Scores
for Testing Across the Levels of Cognition

Case	Levels											
	Percent Remembering			Percent Processing			Percent Creating			Percent Evaluating		
	Asp	Asd	Dsc	Asp	Asd	Dsc	Asp	Asd	Dsc	Asp	Asd	Dsc
1	60	38	22	30	57	-27	0	1	-1	10	4	6
2	40	40	0	30	53	-23	20	2	18	10	5	5
3	50	57	-7	30	40	-10	10	0	10	10	3	7
4	20	0	20	20	0	20	30	100	-70	30	0	30
5	30	62	-32	50	35	15	10	3	7	10	0	10
6	50	38	12	30	47	-17	10	5	5	10	10	0
7	50	31	19	50	56	-6	0	0	0	0	13	-13
8	40	33	7	40	46	-6	0	2	-2	20	19	1
9	30	53	-23	40	35	5	10	7	3	20	5	15
10	10	39	-29	40	43	-3	30	7	23	20	11	9
Mean	38	39	-1.1	36	41	-5.2	12	13	-.7	14	7	7

Note. Asp = aspired, Asd = assessed, Dsc = discrepancy

Dsc = Asp - Asd

**Relationship Between Aspired Cognitive Level of
Instruction and Assessed Cognitive Level of
Instruction**

In describing the relationship between aspired cognitive level of instruction and assessed cognitive level of instruction, the Davis Convention (1971) was used. The coefficients and descriptors are listed below.

<u>Coefficients</u>	<u>Descriptors</u>
.70 and higher	very strong
.50 - .69	substantial
.30 - .49	moderate
.10 - .29	low
.01 - .09	negligible

Table 22 shows Pearson Product Moment Coefficients of Correlation (Pearson r) for the interval x interval data. A low correlation was present between aspired level of discourse at the creating level and assessed level of discourse at the creating level ($r = .23$).

In the testing category, at the processing level a moderate correlation ($r = .42$) was present and at the creating level a substantial correlation ($r = .59$) was present indicating that as participants aspired to write more processing and creating level questions, they were assessed to be writing more processing and creating level questions.

Table 22

Correlations Between Aspired Cognitive Level of Instruction
and Assessed Cognitive Level of Instruction

Level of cognition by category of instruction	Association
<u>Discourse</u>	
Remembering	$r = -.0168$
Processing	$r = .0913$
Creating	$r = .2341$
<u>Evaluating</u>	$r = .1226$
<u>Tests</u>	
Remembering	$r = .2271$
Processing	$r = .4232$
Creating	$r = .5945$
<u>Evaluating</u>	$r = -.1216$

Note. Quizzes and assignments were not analyzed because of the low number of participants using quizzes and assignments as requirements for their classes.

For discourse and tests $n = 10$

Attitude Toward Teaching at Higher Cognitive Levels

Attitude scores ranged from 209 to 264 (mean = 238, $s.d = 17.671$) out of a possible range of 50 to 300 if all items

on the instrument were completed. The mean score of 238 indicated that participants moderately agreed with statements which indicated a more positive attitude toward teaching at higher cognitive levels.

Table 23

Participants' Scores for Attitude Toward
Teaching at Higher Cognitive Levels

<u>Score</u>	<u>Participants</u>
201 - 225	2
226 - 250	5
251 - 275	3
<u>Total</u>	<u>10</u>

Note. Possible range = 50 to 300

Mean = 238

**Relationship Between Aspired Cognitive Level of
Instruction and Attitude Toward Teaching at Higher
Cognitive Levels**

Table 24 contains the correlation coefficients between attitude toward teaching at higher cognitive levels and aspired cognitive level of instruction, as indicated by in-class discourse and written test items at the remembering, processing, creating, and evaluating levels of cognition.

Pearson Product Moment Coefficients of Correlation (Pearson r) were reported for the interval x interval data.

A substantial negative correlation ($r = -.62$) exists between attitude toward teaching at higher cognitive levels and aspiration toward discourse at the remembering level of cognition. Therefore, the higher the attitude toward teaching at higher cognitive levels, the lower the aspiration to conduct discourse at the remembering level.

A substantial positive correlation ($r = .54$) was present between attitude toward teaching at higher cognitive levels and aspiration toward discourse at the creating level of cognition, indicating that the higher the attitude toward teaching at higher cognitive levels, the higher the aspiration to discourse at the creating level. Low and moderate correlations existed for discourse at the processing and evaluating levels.

For testing, a very strong negative correlation ($r = -.79$) exists between attitude toward teaching at higher cognitive levels and aspiration toward testing at the remembering level of cognition. Thus, the higher the attitude toward teaching at higher cognitive levels, the lower the aspiration to test at the remembering level.

A very strong positive correlation ($r = .80$) and a substantial positive correlation ($r = .52$) were present between attitude toward teaching at higher cognitive levels

and aspiration toward testing at the creating and evaluating levels of cognition. Therefore, the higher the attitude toward teaching at higher cognitive levels, the higher the aspiration to test at the creating and evaluating levels. A low negative correlation existed for testing at the processing level.

Table 24

Correlations Between Aspired Cognitive Level of Instruction
and Attitude Toward Teaching at Higher Cognitive Levels

Level of cognition by category of instruction	Association
<u>Discourse</u>	
Remembering	$r = -.6157$
Processing	$r = .2167$
Creating	$r = .5375$
<u>Evaluating</u>	$r = .3732$
<u>Tests</u>	
Remembering	$r = -.7879$
Processing	$r = -.1317$
Creating	$r = .8043$
<u>Evaluating</u>	$r = .5155$

Note. Quizzes and assignments were not analyzed because of the low number of participants using quizzes and assignments as requirements for their classes.

For discourse and tests $n = 10$

**Relationship Between Assessed Cognitive Level of
Instruction and Attitude Toward Teaching At Higher
Cognitive Levels**

The Pearson Product Moment Coefficients of Correlation (Pearson r) between attitude toward teaching at higher cognitive levels and assessed cognitive level of instruction, as determined by in-class discourse and written test items at the remembering, processing, creating and evaluating levels of cognition are found in Table 25. Negligible and low correlations were present between attitude toward teaching at higher cognitive levels and assessed discourse at the creating, evaluating and remembering levels of cognition. A low negative correlation was found for discourse at the processing level.

For testing, low to moderate negative correlations were revealed at the remembering and evaluating levels. A very strong negative correlation ($r = -.72$) was present between attitude toward teaching at higher cognitive levels and assessment of testing at the processing level of cognition. Therefore, the higher the attitude toward teaching at higher cognitive levels, the lower the assessment of test items written at the processing level.

A substantial positive correlation ($r = .54$) was present between attitude toward teaching at higher cognitive levels

and assessment of testing at the creating level. Therefore, the higher the attitude toward teaching at higher cognitive levels, the higher the assessment of test items written at the creating level.

Table 25

Correlations Between Assessed Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels

Level of cognition by category of instruction	Association
<u>Discourse</u>	
Remembering	$r = .1442$
Processing	$r = -.1695$
Creating	$r = .0937$
<u>Evaluating</u>	$r = .0461$
<u>Tests</u>	
Remembering	$r = -.1893$
Processing	$r = -.7154$
Creating	$r = .5441$
<u>Evaluating</u>	$r = -.3108$

Note. Quizzes and assignments were not analyzed because of the low number of participants using quizzes and assignments as requirements for their classes.

For discourse and tests $n = 10$

**Relationship Between Demographic Variables and
Attitude Toward Teaching at Higher Cognitive Levels**

Demographic information was categorized as general demographics, personal demographics, teaching demographics, and familiarity with levels of cognition. Pearson Product Moment Coefficients of Correlation (Pearson r) were calculated for the interval $\times$ interval data. In cases where interval data was not appropriate, the interval scale was converted to an ordinal scale and Spearman Rank Correlation Coefficients (p) were recorded for the ordinal $\times$ ordinal data (rank and time devoted before class to preparing for the class session). Point-biserial Correlation Coefficients (Pearson r) were reported for the nominal $\times$ interval data.

As can be seen in Table 26, moderate positive correlations existed between attitude toward teaching at higher cognitive levels and age ($r = .34$), rank ($p = .40$), tenure status ($r = .36$), and number of cognition workshops previously attended ($r = .47$). These correlations indicated that as age increased, attitude toward teaching at higher cognitive levels tended to increase, as rank and tenure status increased, attitude toward teaching at higher cognitive levels tended to increase, and that as number of cognition workshops previously attended increased, attitude

toward teaching at higher cognitive levels tended to increase.

Table 26

Correlations Between Demographic Variables and Attitude
Toward Teaching at Higher Cognitive Levels

Demographic variables	Association
Age	$r = .3397$
Rank	$p = .4015$
Course level taught	$r = .1291$
Years of university teaching experience	$r = -.1338$
Percent appointment in the general funds budget	$r = -.0028$
Number of courses taught per year	$r = -.1827$
Time devoted before class to preparing for the class session	$p = .2343$
Tenure status	$r = .3597$
Cognition workshops previously attended	$r = .4692$
Number of cognition studies previously involved	$r = -.1324$

Note. $n = 10$. $r = \text{PPM or Point-Biserial}$; $p = \text{Spearman Rho}$.

**Preferred Inservice Topics and Formats Designed for
Reaching Higher Cognitive Level Instruction**

Preferred Inservice Topics

Table 27 displays frequencies and means of inservice topics suggested by participants in this study. The faculty members used a five point Likert scale with "5" = "very favorable" and "1" = "very unfavorable" to describe their feelings toward suggested inservice topics.

The first choice of the participants for an inservice topic, as indicated by the highest mean score (4.7 on a scale of 1 - 5) was "Using higher levels of cognition in my own delivery of instruction". The second choice (mean = 4.5) was "Designing assignments at higher levels of cognition". The least desirable inservice topic, as indicated by the lowest mean score (3.0) was "Implementing a departmental plan for teaching at higher cognitive levels".

Table 27

Preference of Participants for Inservice Topics

Topic	Number of Participants					Mean
	VF	FF	DK	FU	VU	
1. Using higher levels of cognition in my own delivery of instruction.	7	3	0	0	0	4.7
2. Designing assignments at higher levels of cognition.	5	5	0	0	0	4.5
3. Lectures that reach higher levels of cognition.	6	3	0	1	0	4.4
4. Strategies to follow to teach at higher cognitive levels.	5	4	1	0	0	4.4
5. Problem Solving teaching and higher order thinking.	6	3	0	0	1	4.3
6. Writing tests at higher levels of cognition.	5	3	2	0	0	4.3
7. Grading to reward higher level thinking	6	1	1	1	1	4.0
8. A synthesis of research on cognitive levels of instruction.	4	3	2	0	1	3.9
9. An overview of cognitive levels of learning	2	4	2	1	1	3.5
10. Implementing a departmental plan for teaching at higher cognitive levels.	1	3	3	1	2	3.0

Note. n = 10

VF = very favorable, FF = fairly favorable, DK = don't know,

FU = fairly unfavorable, VF = very unfavorable

Preferred Inservice Formats

Participants were asked to rank order a list of suggested formats for offering inservice education regarding teaching at higher cognitive levels. Rank order of preferred formats was determined by summing the participants rank orders of the suggested formats. It can be seen in Table 28 that participants preferred the "Faculty Workshops" format for offering inservice education regarding teaching at higher cognitive levels (score = 21). Second choice of the participants was "One-on-One Interaction" (score = 22). For the ten participants in this study the least favorite inservice format was "Intensive 1 - Week Program" (score = 36).

Table 28

Participants' Preference for Inservice Formats

<u>Suggested format</u>	<u>Sum of rank</u>	<u>Rank order</u>
Faculty workshops	21	1
One-on-one interaction	22	2
Brown bag seminars across one quarter	25	3
Self-paced modules	30	4
Consultation on "as requested" basis	34	5
Intensive 1-week program	36	6

Note. n = 10.

Summary of Findings

Demographics

The ten purposefully selected professors in the College of Agriculture at The Ohio State University who participated in this study taught 100 (freshman) level through 500 (senior) level undergraduate courses in ten different subject matter areas. Their average age was 48 years and one-half of the participants were full professors.

The participants represented an average of 14 years of university teaching experience and the percentage of appointments from the general funds budget ranged from 50% -

100% with a mode of 50%. Faculty members in the study taught an average of five courses per year.

One-half of the participants (5) in this study devoted one hour prior to each class preparing for the class session. Eighty percent (8) of the participants were tenured.

Where knowledge of the levels of cognition was concerned, faculty members had participated in 0 to 6 previous cognition workshops (mean = 2.7). Two participants had been involved in two previous cognition studies in the College of Agriculture.

Aspired Cognitive Level of Instruction

Participants aspired to have approximately 70% of their discourse at the remembering and processing levels. Aspirations for discourse at the creating and evaluating levels ranged from 0 to 30% with a mean of approximately 15%.

Participants in this study aspired to write 75% of their test items at the remembering and processing levels. They sought to write approximately 25% of their test items at the creating and evaluating levels.

Since only two participants in this study used quizzes as requirements for their course, caution must be exercised in interpreting the findings. However, the most extreme range in level of aspiration for quizzes was at the remembering level; one participant aspired to write 10% of

the quiz items at the remembering level while one participant aspired to write 70% of the quiz items at the remembering level.

Caution must be exercised in interpreting the findings for assignments since only five participants used assignments in their courses. Participants aspired to write an average of 12% of their test items at the remembering level. They wanted approximately 60% of their test items to be written at the creating and evaluating levels.

Assessed Cognitive Level of Instruction

Discourse for participants in this study was assessed to be approximately 93% at the remembering and processing levels. Approximately 80% of the test items were found to be at the remembering and processing levels. Forty-five percent of the quizzes ($n = 2$) were assessed at the creating level. Approximately 75% of the assignments were judged to be at the processing or creating levels of cognition.

The majority of the participants in this study (6) wrote 30% - 40% of their test items at the remembering level. With the exception of one participant, all wrote 35% or more of their test items at the processing level. One participant wrote 100% of the test items at the creating level while all other participants wrote fewer than 10% of their items at the

creating level. The maximum percentage of test items written at the evaluating level was nineteen percent.

Discrepancy Between Aspired Level and Assessed Level

No matter what the aspired level for discourse at the remembering level, between 34% - 57% of the participants discourse occurred at the remembering level. All participants achieved a higher percentage of discourse at the processing level than the proportion to which they aspired. No one was assessed as having greater than 10% creating level discourse, no matter the aspiration. Participants failed to reach their aspiration for discourse at the evaluating level by as much 30%.

Relationship Between Aspired and Assessed Cognitive Level of Instruction

Correlation coefficients between aspired cognitive level of instruction and assessed cognitive level of instruction revealed that as participants aspired to write more test items at the processing and creating levels, they were writing more test items at the processing and creating levels.

Attitude Toward Teaching at Higher Cognitive Levels

Participants completed a 50 item Likert scale instrument designed to measure their attitude toward teaching at higher cognitive levels. The mean score on the attitude instrument indicated that participants in the study had attitudes which favored teaching at higher cognitive levels.

Relationship Between Aspired Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels

As attitude toward teaching at higher cognitive levels increased, proportion of discourse and number of test items written at the remembering level decreased. As attitude toward teaching at higher cognitive levels increased, extent of discourse and number of test items written at the creating and evaluating levels also increased.

Relationship Between Assessed Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels

The strongest relationships between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels were in the area of testing. As attitude toward teaching at higher cognitive levels increased, the number of test items written at the remembering, processing, and evaluating levels decreased (strongest relationship at

the processing level). As attitude toward teaching at higher cognitive levels increased, the number of test items written at the creating level increased.

Demographic Relationships

Attitude toward teaching at higher cognitive levels was positively related to increased age, rank, and tenure status. Also, extent of attending cognition workshops was positively related to attitude toward teaching at higher cognitive levels.

Inservice

Participants in this study chose "Using higher levels of cognition in my own delivery of instruction" as their first choice for inservice topics to improve their cognitive level of instruction. The participants chose "faculty workshops" as the first choice format for delivering inservice education on teaching at higher cognitive levels.

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CHAPTER V.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Purpose

The purpose of this study was to describe the aspired cognitive level of instruction, assessed cognitive level of instruction, and attitude toward teaching at higher cognitive levels among selected College of Agriculture professors. This study also examined inservice topics and formats for offering education regarding teaching at higher cognitive levels.

Research Design

This research was descriptive - correlational in nature. Four instruments were utilized to present a detailed explanation of each variable of interest and to answer the following research questions:

1. What are the characteristics of faculty members in the College of Agriculture at The Ohio State University who participated in this study in terms of:
 - a. general demographics
 - course level taught
 - subject matter taught
 - b. personal demographics
 - age
 - rank

- c. teaching demographics
 - years of university teaching experience
 - percent appointment from general funds budget
 - number of courses taught per year
 - amount of time before class devoted to preparing for the class session
 - tenure status
 - d. extent of familiarity with levels of cognition
 - number of cognition workshops attended
 - extent of prior involvement in cognition studies
2. At what level of cognition do participants aspire to teach with respect to in-class discourse, written test items, quizzes and assignments?
 3. At what level of cognition are participants actually teaching as determined by assessment of tests, quizzes and assignments, and assessment of in-class discourse as measured by the Florida Taxonomy of Cognitive Behavior?
 4. What is the relationship between cognitive level of instruction to which participants aspire and actual cognitive level of instruction?
 5. Among participants, what is their attitude toward teaching at higher cognitive levels?
 6. What is the magnitude of the discrepancy between aspired cognitive level of instruction and actual cognitive level of instruction?
 7. What is the relationship between aspired cognitive level of instruction and attitude toward teaching at higher cognitive levels?
 8. What is the relationship between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels?
 9. What is the relationship between demographic information collected and attitude toward teaching at higher cognitive levels?
 10. What inservice topics and inservice formats are requested by participants to assist them in increasing their cognitive level of instruction?

Population and Sample

The target population for this study was 213 faculty members in the College of Agriculture at The Ohio State University. The accessible population was faculty members in the College of Agriculture at The Ohio State University, Columbus campus, who had a teaching appointment on the general funds budget and who were teaching at least one undergraduate course during Autumn Quarter (September 19, 1990 - November 30, 1990).

A purposeful sample of ten professors constituted the participants for this study. Participants who were known by the investigators to be good teachers as indicated by student evaluations, exit interviews with students, and discussions with department chairs, and who were interested in improving their instruction, as witnessed by attendance at teaching forums and workshops, were selected.

Instrumentation

The nature of the variables involved in this study required that a variety of instruments be used. A panel of experts consisting of Dr. L. H. Newcomb, Dr. Charles Miller, and Marilyn Trefz, researchers in the area of cognitive levels of teaching and learning, and Dr. Emmalou Norland, Dr.

N. L. McCaslin, validated each instrument used in the study. A summary of instrumentation is presented in this section.

Aspired cognitive level

Aspired cognitive level of instruction was measured by asking the participants to place 10 chips, in proportion to their aspiration, on each of four quadrants on a posterboard marked remembering, processing, creating, and evaluating. The number of chips placed on each quadrant were recorded by the research assistant as percentages of one hundred. A test/retest procedure was adopted to acquire the reliability for this methodology.

Assessed cognitive level

The Florida Taxonomy of Cognitive Behavior was used to assess cognitive level of discourse. This instrument is based upon Bloom's Taxonomy and is designed to identify specific cognitive behaviors. Each participant was assessed three times during autumn quarter. Validity for this instrument was based upon it's direct development from Bloom's Taxonomy and the support generally given to this hierarchy of cognitive behaviors. Reliability for this instrument was established by coding videotapes of lectures. Intra-rater reliability was approximately $p = .96$. Inter-rater reliability was about $p = .98$.

For written materials, each item was assessed using Bloom's Taxonomy of Educational Objectives (Bloom, 1956) and the categories on the Florida Taxonomy of Cognitive Behavior instrument. After assessment the researcher met one-on-one with participants to confer on each item. Reliability was established by assessing tests on file from a previous study and conferring with previous researchers.

Attitude Toward Teaching at Higher Cognitive Levels

Attitude toward teaching at higher cognitive levels was measured using a 50 item, seven point Likert scale instrument developed by the researcher. Reliability was calculated at $r = .86$ using Cronbach's Alpha.

Demographic Information

The researcher developed a two-part instrument to collect demographic information about the participants in the study. Part one was designed to be completed by the participant while part two consisted of information which could be obtained from university records.

Inservice Topics and Formats

An instrument designed to discover preferences for inservice topics and inservice formats was developed by the researcher. Preferred topics were found by using a 10 item,

five point Likert scale on which reliability was established at $r = .86$. Preferred formats were rank ordered by the participants.

Data collection

Measuring Aspiration to Teach at

Higher Cognitive Levels

Aspiration to teach at higher cognitive levels was determined through personal interviews. The interviews were conducted by a research assistant one week before the beginning of autumn quarter.

Assessing Actual Cognitive Level of Instruction

Discourse

Using the Florida Taxonomy of Cognitive Behavior (FTCB), professors were observed during the second week of the quarter, the fifth week of the quarter and the eighth week of the quarter. The researcher audio-taped each class session.

Tests, Quizzes and Assignments

The researcher collected tests, quizzes and assignments as the materials were prepared by the professor. Assessment of each item on every examination, test, quiz, and assignment was made as the materials were collected. At the

participant's convenience, the researcher met with the faculty member to review the item assessments and reach consensus as to the classification of each item.

Measuring Attitude Toward Teaching at Higher Cognitive Levels

The instrument, "Professor's Attitude Toward Teaching at Higher Cognitive Levels" designed by the researcher, was presented to the participants by the research assistant during the first meeting with the participants one week before Autumn Quarter. Participants mailed the instrument to the researcher within one week.

Acquiring Demographic Information

Demographic information was acquired in two parts. Part one was collected by the research assistant during the first meeting with professors; one week before Autumn Quarter began. Part two was collected, with permission of participants, from University records. This was done during the fourth week of the Autumn Quarter

Finding Preferred Inservice Topics and Formats

Inservice topics and inservice formats requested by the participants in this study to assist them in teaching at higher cognitive levels were determined during the final

meeting with participants using an instrument developed by the researcher. Final meetings were scheduled during either the tenth or the eleventh week of the quarter.

Data Analysis

The Statistical Package for the Social Sciences (SPSSx/PC+) computer package was used to analyze the data. For each variable in the study, measures of central tendency and frequency distributions were generated and then used to describe the sample. Pearson Product Moment Coefficients of Correlation (Pearson r) and Spearman Rho (ρ) Coefficients of Correlation were calculated.

Analyzing Aspiration to Teach at Higher Cognitive Levels

The aspired cognitive level of teaching was recorded for discourse, written test items, quizzes and assignments at four levels of cognition, i.e. remembering, processing, creating, and evaluating. The data for aspired cognitive level of instruction were compared to the data for assessed cognitive level of instruction to determine discrepancies. The data were also correlated with assessed cognitive level and attitude toward teaching at higher cognitive levels.

Analyzing Cognitive Level of Instruction

Discourse

Cognitive level of discourse was calculated using the process employed by Pickford (1988). For each class session a calculation was made of the number of times cognitive behavior occurred across the levels of cognition. The three observations were summed for total frequencies at each level. Percentages for each level were calculated for each class observation. The data were also correlated with assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels.

Tests, Quizzes and Assignments

Tests, quizzes and assignments were analyzed using a process developed by Newcomb and Trefz (1987). The total number of items at each level of cognition was divided into the total number of items to obtain the percentage of items at each level. These data were also correlated with assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels. Due to the low number of participants utilizing quizzes ($n = 2$) and assignments ($n = 5$) minimal analysis of these measurements was completed.

Analyzing Attitude Toward Teaching at
Higher Cognitive Levels

Fifty Likert scale entries were summed to yield a score representing the attitude toward teaching at higher cognitive levels. This score was correlated with aspired cognitive level of instruction, assessed cognitive level of instruction, and demographic information. Means and frequencies were also examined.

Analyzing Demographic Information

Means and frequencies of all demographic information was calculated. These data were then correlated with the scores for attitude toward teaching at higher cognitive levels.

Determining Preference for Inservice Topics and Formats

Inservice topics preferred by the participants were determined by calculating means and frequencies of the Likert scale items. The highest mean was reported as the first choice selection. Summing the rank ordered entries for inservice formats provided data to determine the participants' preferences for inservice formats. The lowest sum of the rank order items was recorded as the first choice selection.

Summary of Findings

Demographics

The ten purposefully selected professors in the College of Agriculture at The Ohio State University who participated in this study taught 100 (freshman) level through 500 (senior) level undergraduate courses in ten different subject matter areas. Their average age was 48 years and one-half of the participants were full professors.

The participants represented an average of 14 years of university teaching experience and the percentage of appointments from the general funds budget ranged from 50% - 100% with a mode of 50%. Faculty members in the study taught an average of five courses per year.

One-half of the participants (5) in this study devoted one hour prior to each class preparing for the class session. Eighty percent (8) of the participants were tenured.

Where knowledge of the levels of cognition was concerned, faculty members had participated in 0 to 6 previous cognition workshops (mean = 2.7). Two participants had been involved in two previous cognition studies in the College of Agriculture.

Aspired Cognitive Level of Instruction

Participants aspired to have approximately 70% of their discourse at the remembering and processing levels.

Aspirations for discourse at the creating and evaluating levels ranged from 0 to 30% with a mean of approximately 15%.

Participants in this study aspired to write 75% of their test items at the remembering and processing levels. They sought to write approximately 25% of their test items at the creating and evaluating levels.

Since only two participants in this study used quizzes as requirements for their course, caution must be exercised in interpreting the findings. However, the most extreme range in level of aspiration for quizzes was at the remembering level; one participant aspired to write 10% of the quiz items at the remembering level while one participant aspired to write 70% of the quiz items at the remembering level.

Caution must be exercised in interpreting the findings for assignments since only five participants used assignments in their courses. Participants aspired to write an average of 12% of their test items at the remembering level. They wanted approximately 60% of their test items to be written at the creating and evaluating levels.

Assessed Cognitive Level of Instruction

Discourse for participants in this study was assessed to be approximately 93% at the remembering and processing levels. Approximately 80% of the test items were found to be at the remembering and processing levels. Forty-five percent of the quizzes (n = 2) were assessed at the creating level. Approximately 75% of the assignments were judged to be at the processing or creating levels of cognition.

The majority of the participants in this study (6) wrote 30% - 40% of their test items at the remembering level. With the exception of one participant, all wrote 35% or more of their test items at the processing level. One participant wrote 100% of the test items at the creating level while all other participants wrote fewer than 10% of their items at the creating level. The maximum percentage of test items written at the evaluating level was nineteen percent.

Discrepancy Between Aspired Levels and Assessed Levels

No matter what the aspired level for discourse at the remembering level, between 34% - 57% of the participants discourse occurred at the remembering level. All participants achieved a higher percentage of discourse at the processing level than the proportion to which they aspired. No one was assessed as having greater than 10% creating level discourse, no matter the aspiration. Participants failed to

reach their aspiration for discourse at the evaluating level by as much 30%.

Relationship Between Aspired
and Assessed Cognitive Level of Instruction

Correlation coefficients between aspired cognitive level of instruction and assessed cognitive level of instruction revealed that as participants aspired to write more test items at the processing and creating levels, they were writing more test items at the processing and creating levels.

Attitude Toward Teaching at Higher Cognitive Levels

Participants completed a 50 item Likert scale instrument designed to measure their attitude toward teaching at higher cognitive levels. The mean score on the attitude instrument indicated that participants in the study had attitudes which favored teaching at higher cognitive levels.

Relationship Between Aspired Cognitive Level of Instruction
and Attitude Toward Teaching at Higher Cognitive Levels

As attitude toward teaching at higher cognitive levels increased, proportion of discourse and number of test items written at the remembering level decreased. As attitude toward teaching at higher cognitive levels increased, extent

of discourse and number of test items written at the creating and evaluating levels also increased.

Relationship Between Assessed Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels

The strongest relationships between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels were in the area of testing. As attitude toward teaching at higher cognitive levels increased, the number of test items written at the remembering, processing, and evaluating levels decreased (strongest relationship at the processing level). As attitude toward teaching at higher cognitive levels increased, the number of test items written at the creating level increased.

Demographic Relationships

Attitude toward teaching at higher cognitive levels was positively related to increased age, rank, and extent of attending cognition workshops. However, attitude toward teaching at higher cognitive levels was negatively related to achieving tenure.

Inservice

Participants in this study chose "Using higher levels of cognition in my own delivery of instruction" as their

first choice for inservice topics to improve their cognitive level of instruction. The participants chose "faculty workshops" as the first choice format for delivering inservice education on teaching at higher cognitive levels.

Conclusions

The following conclusions are based upon the researcher's interpretation of the results of this study.

Conclusion 1. Participants in this study primarily aspired for their discourse and testing to be at the remembering and processing levels of cognition. There was much less aspiration among participants to conduct discourse or write test items at the creating and evaluating levels. This was the case for all professors no matter what the subject matter or course level.

Conclusion 2 The faculty members in this study conducted discourse primarily at the processing level of cognition, but tested at the remembering and processing levels. They tested very little at the creating and evaluating levels and taught even less at those levels.

Conclusion 3 The participants in this study aspired to teach and test at cognitive levels higher than those at which they were assessed.

Conclusion 4 Regardless of the cognitive level to which faculty members in this study aspired to conduct discourse,

they conducted discourse at about the same level. There was little discourse at the creating and evaluating levels.

Conclusion 5 Generally, participants in this study who aspired to write test items at the processing and creating levels wrote more test items at the processing and creating levels. This was less true at the remembering level and was not the case at the evaluating level.

Conclusion 6 Participants in this study had favorable attitudes toward teaching at higher cognitive levels.

Conclusion 7 Faculty members in this study who had more favorable attitudes toward teaching at higher cognitive levels wanted their discourse and testing to be less at the remembering level and more at the creating and evaluating levels.

Conclusion 8 Participants who had a more favorable attitude toward teaching at higher cognitive levels tested less at the processing and evaluating level and more at the creating level. However, the cognitive level of discourse was not associated with attitude toward teaching at higher cognitive levels.

Conclusion 9 More experienced professors had more favorable attitudes toward teaching at higher cognitive levels.

Conclusion 10 Participants were most interested in inservice topics which provided them with immediate

application, i.e. delivery of instruction and writing assignments. They felt that the method of delivery most convenient to them would be faculty workshops.

Discussion

The goal of this research was to provide insight into the cognitive level of instruction, specifically aspired cognitive level of instruction, assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels among selected College of Agriculture professors. In order for students to graduate from institutions of higher education equipped with the ability to think at the upper cognitive levels, professors must take an active role in assisting students to develop higher level thinking skills through effective instruction.

This discussion section is designed to further unveil knowledge revealed in this study about teaching at higher cognitive levels. Specific topics included are: cognitive level of discourse (as revealed in a number of studies), reaching higher cognitive level instruction, testing, and using assignments.

Cognitive level of discourse

This study was grounded in Bloom's theory of educational objectives in the cognitive domain (Bloom, 1956)

which emphasizes the importance of offering lower level (remembering and processing) information to students as a basis on which to move to the upper levels of cognition (creating and evaluating). However, professors may be presenting a greater proportion of lower level information than is necessary or desired.

The data from this study shows that professors conduct discourse at lower levels of cognition (remembering and processing) 98% of the time. These data are consistent with previous studies (Pickford, 1988; Miller, 1989) whose findings for discourse across the cognitive levels are displayed in Table 29. It can be seen in the table that Pickford reported 94% of the discourse was conducted at the lower levels of cognition while Miller found professors conducting lower level discourse 98% of the time.

Table 29

Comparison of Cognitive Level of Discourse Across Studies

	Mean percent of discourse			
	Pickford	Miller	Whittington	Mean
Cognitive level				
Remembering	46	40	42	42.6
Processing	48	58	53	53.0
Creating	3	<1	5	2.8
Evaluating	3	1.0	<1	1.5

Note. Pickford, 1988 (n = 3); Miller, 1989 (n = 4);
Whittington, 1991 (n = 10).

High percentages of lower level discourse across these three studies were found for a total of 17 professors teaching a wide variety of subject matter to students at various course levels. This comparison of studies provides further evidence that professors in the College of Agriculture are conducting discourse primarily at the lower levels of cognition and thus limiting students' opportunities to observe and practice higher level thinking.

Why instructors are conducting such high percentages of discourse at the lower levels is not known. One could

speculate that this is "normal" and cannot be changed. More than likely, this is not the case.

Perhaps professors do not know how to reach creating and evaluating levels of cognition in their discourse. It is also possible that they believe they have no time to re-evaluate and re-write lesson plans to prepare for evaluating and creating level discourse. It may be too frustrating for them to try to teach at higher cognitive levels.

It is also possible that professors feel apprehensive about making vast changes toward teaching at higher cognitive levels when the theory is still being developed. Professors may not fully understand the long term effects teaching at higher cognitive levels can have on students. They may not be aware of the number of weeks, months, years that it might take to persevere in order to change their cognitive level of teaching. It is also possible that professors do not appreciate the challenge that teaching at higher cognitive levels can provide for professors and for students.

The Department of Agricultural Education at The Ohio State University has attempted to remove these barriers by offering faculty and graduate student workshops on various topics related to teaching and learning at higher cognitive levels. These workshops should continue to be offered if progress is to be made in having more professors conducting a

greater portion of their discourse at the upper levels of cognition.

However, there is more to teaching than discourse. Thus there are additional possibilities for providing more of this instruction at the higher levels of cognition. In addition to higher level discourse, professors can provide learning experiences in the classroom and outside of the classroom, but one must first plan and prepare for experiences at the upper levels of cognition. This is the focus of the following sections.

Reaching Higher Cognitive Level Instruction

Prior to teaching

It is speculated that with knowledge of teaching methods and with time professors can provide a greater portion of their instruction at the higher levels of cognition. They need to be taught to use the principles of teaching and learning, primary and secondary principles of interest, a greater variety of group and individual teaching techniques, and the categories on the FTCE. This knowledge needs to be drawn upon as they prepare lesson plans. In this way professors can purposefully plan the words, methods, and visuals needed to reach the creating and evaluating levels of cognition in the classroom. They need to know how to evaluate their own lesson plans or be willing to share their

lesson plans with peers who can assist them with planning for classroom opportunities to model higher level thinking.

Professors should also plan to regularly observe other professors as they teach. Much can be learned from colleagues who have a reputation for good teaching.

In class learning experiences

Professors in this study were proficient at using words to reach the application level (part of the processing level), but many times spoken examples desperately needed to be supplemented with a hands-on example, a demonstration, or an experiment which would use higher level thought processes and lead students to think at the higher levels of cognition.

Testing.

Once professors have modeled higher order thinking in their classrooms, testing students at the upper levels of cognition can be a means for adding rigor to their courses. However, testing at the higher cognitive levels without first demonstrating higher level thought processes for students adds frustration rather than rigor.

One participant in this study wrote 100% creating level tests. Before implementing 100% creating level testing, professors should answer the following questions: How will I model the creating level of cognition during lecture, prior

to expecting students to operate at the creating level on tests? How will I grade the creating level tests? Is it beneficial to my students to offer only one option for measuring performance or should other forms of measurement be available for students who do not excel at writing?

The participant who wrote 100% creating level tests was an exception. Professors in this study most often used two midterm examinations and one final examination consisting of a combination of objective and subjective items written primarily at the remembering and processing levels of cognition. However, a participant in the study who offered tests consisting of a variety of objective and subjective items stated, "My students did well on the higher cognitive part of my exam, but they did poorly on the lower level, multiple choice items". This was puzzling because remembering level assessment should be inherent in the higher cognitive level test items. Thus students who performed well at the higher levels of cognition, should have performed well at the lower levels of cognition.

Assignments.

Participants in this study used tests as their primary tool for measuring student performance. Very few required assignments and fewer used quizzes. Participants in this study who wrote assignments were writing them at the creating

level. Based on previous research, this finding is not surprising.

Newcomb & Trefz (1987), Pickford (1988), and Miller (1989), found that assignments more than any other measure of student performance enabled students to reach higher cognitive levels. Professors need to use this valuable tool to assist them in having students think at the higher cognitive levels and to provide them with more opportunities for a variety of grades and a variety of measures of performance.

Out of class learning experiences

Professors can provide opportunities for students to reach higher cognitive levels outside of the classroom. Experiences such as outside reading from the chosen text and other sources, laboratory experiments and projects, field trips, and discussion groups can be designed to increase the cognitive level of the course. Table 30 portrays a comparison of the level of discourse between one participant's observed lectures ($n = 3$) and the participant's discussion group ($n = 1$). As can be seen in the table, this participant's discourse during discussion group was less at the remembering level, more at the processing level and more at the creating level than was the case for the participant's lectures.

Table 30

Comparison of Cognitive Level of Discussion Group Versus
Lecture

	<u>Teaching method</u>	
	<u>Percent of lecture</u>	<u>Percent of discussion</u>
<u>Cognitive level</u>		
Remembering	57	34
Processing	38	51
Creating	5	13
Evaluating	0	0

Note. Percent of lecture represents the mean of the data from three observations. Percent of discussion represents data from one discussion.

Summary of discussion

Upon considering this study and the previous cognition research of Newcomb & Trefz (1987), Pickford (1988), and Miller (1989), one can speculate that students entering a College of Agriculture today could expect to be taught by lectures delivered primarily at the processing level. They could expect to hear very little if any lecturing at the creating and evaluating levels.

Students could expect to be tested using two midterms and one final, all written predominantly at the remembering and processing levels with occasional items written at the evaluating level. Occasionally the students might take a class that requires assignments; the assignments would be written at the creating level. Regardless of the subject matter, course level, or experience of the professor, this would be the scenario.

The scenario could change as professors work to model higher levels of cognition in their classrooms and then assess student performance at those levels by writing tests with less remembering level items and more creating and evaluating level items, and by requiring assignments written at the higher cognitive levels.

Recommendations

Recommendations for Instruction

1. More cognition workshops should be offered to faculty members by those studying cognitive levels of teaching and learning. Faculty members, especially young faculty members should be encouraged to attend.
2. Participants in this study requested inservice topics with immediate application. It is recommended that one such topic be writing lesson plans at higher cognitive levels. Professors should be taught to write objectives that reflect

teaching at higher cognitive levels and develop learning experiences which would facilitate higher level learning.

3. It is recommended that professors devote more time to talking with one another about teaching. Professors need to encourage peers and colleagues to give attention to teaching at higher cognitive levels.

4. It is recommended that students be tested at the upper levels of cognition only after higher order thinking has been modeled for the students in the classroom.

5. It is recommended that professors test less at the remembering level.

6. Participants in this study primarily used tests to assess student performance. It is recommended that professors use assignments to challenge students to reach higher levels of cognition and to measure student performance at higher levels of cognition.

7. It is recommended that professors make major conscientious changes in their current teaching style to reach the cognitive levels at which they aspire to teach.

Recommendations for further research

1. Develop an instrument for assessing classroom discourse that provides the researcher with equal opportunities to record behaviors across all levels of cognition.

2. Compare item analyses of examinations with the assessment of items at each level of cognition. Compare the cognitive level of items to percentage of discourse across the levels of cognition. Examine student performance at various levels of cognition. Compare student performance across the levels of cognition with professor discourse across the levels of cognition to student variables such as ACT scores, class rank, high school track, learning style and other student variables.
3. Additional study is needed to determine the extent to which laboratories, discussion groups, field trips and other activities provided by the professor outside of the classroom situation contribute to higher cognitive levels of instruction.
4. A future study should develop a regression model for establishing contributions of professor variables and student variables to higher level thinking of students.
5. Continue research which will lead to developing recommendations for appropriate percentage of discourse at each level of cognition, sufficient number of written test items at each level of cognition, and necessary cognitive level of assignments for various subject matter and course level

6. Select professors who are teaching undergraduate and graduate courses during the same quarter and assess their teaching level between the courses.
7. Re-administer final course examinations to students one year after completion of the course to assess the cognitive level of items retained by the student.
8. A study should be conducted to examine the difference in cognitive level of instruction following an intensive intervention program on cognitive levels of teaching and learning.

Appendices

Appendix A
Correspondence

Marilyn Trefz
Haggerty Hall
The Ohio State University

July 23, 1990

Dear Marilyn:

As per our telephone conversation today, I am mailing to you a copy of an instrument to be used in my dissertation work. As you know, I am studying levels of cognition, which is an area in which you possess expertise

I am asking for your assistance in validating the instrument for content validity. Specifically, I am asking that you assist with item clarity, and appropriateness in measuring "professor attitudes toward teaching at higher cognitive levels".

Thank you for your assistance in this important matter. Please return the instrument in the self-addressed, stamped envelope that I have provided. I look forward to reading your valuable input.

Sincerely

Susie Whittington
Graduate Research Associate
The Ohio State University

Date: August 15, 1990

To: Selected College of Agriculture Professors

From: L. H. Newcomb

Re: College Research

In a few days, one of my students, Susie Whittington, will be in touch with you requesting your participation in pilot testing instruments for her dissertation study. This will require 15 minutes or less of your time on two different occasions.

I hope you will be willing to help Ms. Whittington with this investigation.

August 17, 1990

Dr. Tom Turner
110 Animal Science Building
Columbus, OH 43210

Dear Dr. Turner:

University communities across the nation are currently caught in a sweeping movement to revise the undergraduate curriculum. One aspect of the revision includes teaching students to think critically.

In an attempt to meet the high standards of the curriculum revision, the Department of Agricultural Education has been involved in programmatic research that studies levels of cognition of College of Agriculture professors and students. Thanks to professors who are concerned about their teaching and have been willing to participate in this research, student and professor levels of cognition have continued to be studied since 1987.

I am writing to ask for your participation in pilot testing the fourth phase of this ongoing research. Participation in pilot testing would require you to complete three questionnaires. Two of the questionnaires would be completed twice, one week apart.

The questionnaires are enclosed in this mailing. Would you please take about fifteen minutes of your time to complete all three questionnaires and return them to me in the enclosed, addressed campus envelope? I would appreciate receiving the completed questionnaires within the week. One week after receiving your completed questionnaires I will mail the two smaller questionnaires for you to complete a second time.

Thank you for cooperating in this worthwhile study of cognitive levels of instruction. Your participation will add to the possibility of making a difference in the thinking ability of current and future College of Agriculture and School of Natural resources students. I anxiously wait to receive your completed questionnaires.

Sincerely,

Susie Whittington
Graduate Research Associate

Date: August 15, 1990
To: Selected College of Agriculture Professors
From: L. H. Newcomb
Re: College Research

In a few days, one of my students, Susie Whittington, will be in touch with you requesting your participation during fall quarter in her dissertation study. This will require you to complete three questionnaires, an interview, and will require that you allow her to observe in your classroom three times during the quarter. Her cover letter outlines details of the time commitment.

I hope you will be willing to help Ms. Whittington with this investigation.

August 17, 1990

Dr. Fred Stephens
Lane Ave.
Columbus, OH 43210

Dear Dr. Stephens:

University communities across the nation are currently caught in a sweeping movement to revise the undergraduate curriculum. One aspect of the revision includes teaching students to think critically.

In an attempt to meet the high standards of the curriculum revision, the Department of Agricultural Education has been involved in programmatic research that studies levels of cognition of College of Agriculture professors and students. Thanks to professors who are concerned about their teaching and have been willing to participate in this research, student and professor levels of cognition have continued to be studied since 1987.

I am writing to ask for your participation in the fourth phase of this ongoing research. During Fall Quarter, 1990, I would like to be able to collect information about the level of cognition of your teaching by interviewing you and by observing you as you lecture. Participation in the study would require you to complete three questionnaires. The first questionnaire and interview would be completed during early September. The second questionnaire would be completed on your own during the last week of Fall quarter. The third questionnaire and interview would be completed at the end of Fall Quarter. You would also be requested to allow me to observe in your classroom three times during Fall Quarter.

I would certainly appreciate you allowing me the opportunity to include you as one of ten professors in this dissertation research. I will call on you after August 20, 1990, to discuss your willingness to participate in this study. At that time I will also schedule a meeting to further discuss details of the project and to share with you the instruments used for this research.

Thank you for considering participation in this worthwhile study of cognitive levels of instruction. Your participation will add to the possibility of making a difference in the thinking ability of current and future College of Agriculture and School of Natural resources students. I anxiously wait to hear your decision.

Sincerely,

Susie Whittington
Graduate Research Associate

September 10, 1990

To: Participants in my dissertation pilot study
From: Susie Whittington, Graduate Research Associate
Re: Test/Retest of instruments

Thank you for your participation in pilot testing the instruments for the fourth phase of research concerning cognitive levels of teaching and learning in the College of Agriculture. As promised, participation in pilot testing this study requires that you complete two of the questionnaires twice.

The questionnaires are enclosed in this mailing. Would you please take about ten minutes of your time to complete both questionnaires and return them to me in the enclosed, addressed campus envelope? I would appreciate receiving the completed questionnaires within the week.

Thank you for your cooperation. I anxiously wait to receive your completed questionnaires.

September 12, 1990

To: Participants in my dissertation pilot study
From: Susie Whittington, Graduate Research Associate
Re: Pilot testing of instruments

A few weeks ago I wrote a letter asking for your participation in pilot testing three instruments for my dissertation research. As of September 12, I had not received your completed questionnaires. If they have been mailed, please disregard this note.

I am writing to ask that you consider taking about fifteen minutes of your time to complete the questionnaires received in the previous mailing and return them to me in the self-addressed campus envelope. The two smaller questionnaires will be mailed for completion a second time one week after receiving the completed questionnaires.

Thank you for considering pilot testing the instruments for the fourth phase of research concerning cognitive levels of teaching and learning in the College of Agriculture. I appreciate your cooperation and anxiously wait to receive your completed questionnaires.

Date: September 20, 1990

To: Selected College of Agriculture Professors

From: L. H. Newcomb

Re: College Research

Thank you for participating in the dissertation research of one of my students, Susie Whittington. Your participation was greatly appreciated.

September 23, 1990

To: Participants in my dissertation pilot study
From: Susie Whittington, Graduate Research Associate
Re: Thank you!

Thank you for your willingness to participate in pilot testing the instruments for my dissertation. I really appreciate the time you spent responding to the questionnaires. Your comments were valuable. They were read carefully and considered thoughtfully.

It is hoped that this line of inquiry will contribute to knowledge concerning cognitive levels of instruction in the College of Agriculture. You have played an important role in this endeavor. Thank you again for your participation!

May 15, 1991

To: Participants in my dissertation study
From: Susie Whittington, Graduate Research Associate
Re: Thank you!

Thank you for your willingness to participate in my dissertation research. I really appreciate the time you spent responding to the questionnaires. Your comments were valuable. They were read carefully and considered thoughtfully. More than that I thank you for allowing me to observe in your classrooms. My study was enriched by being present in your classrooms to hear you teach.

It is hoped that this line of inquiry will contribute to knowledge concerning cognitive levels of instruction in the College of Agriculture. You have played an important role in this endeavor. Thank you again for your participation!

Enclosed please find Chapter V of my study, and selected Tables. Should you be interested in further details of the study I would be more than happy to discuss any of the research with you at anytime. Thank you again.

Sincerely,

Susie Whittington
Graduate Research Associate

Appendix B
Demographic Instrument

Demographic Information of Professors

PART I - COMPLETED BY THE PARTICIPATING PROFESSOR

1. Please indicate your top three areas of research interest
 1. _____
 2. _____
 3. _____
2. Are you pleased that you have been assigned to teach this course Fall Quarter, 1990? (circle one)
 1. NO
 2. YES
3. Before each class that I teach, I prepare for an average of (circle one)
 - a. less than 30 minutes before class
 - b. 30 minutes before class
 - c. 1 hour before class
 - d. more than one hour before class

5. Please indicate the number of cognition workshops you have attended (circle highest number attended)
- a. 1
 - b. 2
 - c. 3
 - d. 4
 - e. 5
 - f. 6
6. Please indicate whether you have participated in previous cognition research in the college of agriculture at the Ohio State University (circle appropriate response)
- 1. NO
 - 2. YES (if yes respond to number 14).
7. In how many previous cognition studies have you participated (circle the highest number participated)
- a. 1
 - b. 2
 - c. 3

Thank you for your cooperation!

PART II - COMPLETED FROM UNIVERSITY RECORDS

8. Please indicate your age

_____ years

9. What is your rank? (circle one)

a. assistant professor

b. associate professor

c. full professor

d. other

10. Please indicate your total number of years of university teaching experience

_____ years

11. Please indicate your percent teaching appointment

_____ %

12. What is the average number of courses you teach per year? (circle one)

a. 1

b. 2

c. 3

d. 4

e. 5

f. 6

g. more than 6

13. The title and number of the course in which I am being assessed this fall quarter is:

a. _____

14. Do you have tenure?

1. NO

2. YES

Thank you for your cooperation!

Appendix C
Brief Plan

INSTRUCTION IN LEVELS OF COGNITION

THANK YOU FOR AGREEING TO PARTICIPATE IN THIS STUDY. I KNOW MS. WHITTINGTON IS VERY APPRECIATIVE OF YOUR WILLINGNESS TO TAKE TIME OUT OF YOUR BUSY SCHEDULE TO TAKE PART IN THIS PROJECT.

THIS MORNING (AFTERNOON) I WILL BEGIN BY ASKING YOU A FEW QUESTIONS ABOUT YOURSELF.

AS YOU ARE AWARE FROM YOUR CONVERSATION WITH SUSIE WHITTINGTON, SHE IS GOING TO BE OBSERVING PROFESSORS TO RECORD WHAT THEY SAY, TEST AND ASSIGN THAT MIGHT ASSIST STUDENTS IN REACHING HIGHER COGNITIVE LEVELS.

I WANT TO INTRODUCE YOU TO THE MODEL OF COGNITION WHICH WILL BE USED IN THIS STUDY. THE TERMINOLOGY I WILL BE USING THIS MORNING (AFTERNOON) IS BASED ON BLOOM'S HIERARCHY OF LEARNING OBJECTIVES, BUT IT HAS BEEN MODIFIED/TRANSFORMED INTO SIMPLER LANGUAGE.

COGNITIVE LEVELS OF LEARNING

A. REMEMBERING

1. INVOLVES THE ABILITY TO MEMORIZE AND RECALL
 - * SIMPLE, CONCRETE FACTS, DEFINITIONS, DATES
 - * CLASSIFYING OR CATEGORIZING THESE FACTS
 - * COMPLEX, ABSTRACT THEORIES OR GENERALIZATIONS
2. NO UNDERSTANDING OF THE CONCEPTS OR PRINCIPLES IS REQUIRED.

B. PROCESSING

1. INVOLVES USE OF KNOWN FACTS, PRINCIPLES
 - * COMPREHENSION OF MEANING AND INTENT
 - * APPLICATION TO NEW AND UNIQUE SITUATIONS
 - * ANALYSIS OF INFORMATION TO FACILITATE PROBLEM SOLVING

C. CREATING

1. ABILITY TO COMBINE PIECES OF INFORMATION INTO A FORM NEW TO THE STUDENT
2. OPPORTUNITY FOR INDEPENDENT THINKING, SELF-EXPRESSION
3. DEVELOPMENT OF A PRODUCT
 - * COMMUNICATION EXPRESSING UNIQUE IDEAS, FEELINGS, EXPERIENCES
 - * PLAN OR SOLUTION TO A PARTICULAR SITUATION
4. THE PRODUCT CAN INFORM, DESCRIBE, PERSUADE, IMPRESS OR ENTERTAIN.

1. ABILITY TO MAKE A JUDGMENT OR CRITICAL EVALUATION FOR A GIVEN SET OF INFORMATION BASED UPON A STANDARD OR SPECIFIC CRITERIA.
2. TYPES OF CRITERIA
 - * INTERNAL EVIDENCE - ASSESSING ACCURACY, CONSISTENCY AND LOGIC OF THE MATERIAL
 - * EXTERNAL EVIDENCE - APPLYING ESTABLISHED CRITERIA TO JUDGE OR EVALUATE
3. CRITERIA MAY BE ESTABLISHED STANDARDS OR THOSE DETERMINED BY THE STUDENT.

LIMITED RESEARCH HAS BEEN CONDUCTED ON THE COGNITIVE LEVELS OF COLLEGE TEACHING.

THAT WHICH HAS BEEN DOES INDICATES THAT THE MAJORITY OF ORAL PRESENTATIONS BY TEACHERS, AS WELL AS THE TEXTBOOKS AND EXAMINATIONS USED, TYPICALLY REFLECT THINKING AT THE LOWER LEVELS OF COGNITION (KNOWLEDGE, COMPREHENSION, APPLICATION) (MILLER, 1989).

DISCOURSE IN COLLEGE COURSES WAS FOUND TO BE PREDOMINATELY AT THE LOWEST LEVELS OF COGNITION (FISCHER & GRANT, 1983).

SEVERAL RESEARCHERS REPORTED THAT COLLEGE STUDENTS, EVEN AFTER FOUR YEARS OF HIGHER EDUCATION, MADE JUDGMENTS BASED UPON UNEXAMINED PERSONAL PREFERENCES RATHER THAN SPECIFIC CRITERIA/STANDARDS (BELENKY et. al., 1986; KING et. al., 1983; WELFEL, 1982).

COGNITION RESEARCH AT THE OHIO STATE UNIVERSITY

NEWCOMB & TREFZ (1987) ASSESSED THE TESTS, QUIZZES AND ASSIGNMENTS USED BY PROFESSORS IN THE COLLEGE OF AGRICULTURE. THEY FOUND:

- * 37% OF LEARNING - REMEMBERING LEVEL
- * 61 % OF TESTS/QUIZZES - REMEMBERING LEVEL
- * OUT-OF-CLASS ASSIGNMENTS & ACTIVITIES - HIGHER LEVELS OF COGNITION

THIS WORK WAS EXPANDED BY PICKFORD (1988) WHO STUDIED PROFESSOR DISCOURSE, AND MILLER (1989) WHO STUDIED THE RELATIONSHIP BETWEEN STUDENT VARIABLES AND PROFESSOR VARIABLES.

EMERGING THEMES:

INSTRUCTOR DISCOURSE OCCURRED, ALMOST EXCLUSIVELY, AT LOWER LEVELS OF COGNITION. ALTHOUGH HERE THE WORD 'LOWER' IS USED, IT DOES NOT INDICATE THAT THIS IS OF LESS VALUE. IN FACT, DEPENDING UPON THE COURSE BEING TAUGHT, ONE MIGHT FULLY EXPECT THE MAJORITY OF CONTENT BEING PRESENTED TO BE AT THIS LEVEL.

ASSIGNMENTS FAR EXCEEDED OTHER VARIABLES ON ASSESSING STUDENT ABILITIES AT THE HIGHER LEVELS OF COGNITION. HOWEVER THESE OPPORTUNITIES, WHEN USED, WERE NOT WEIGHTED AS HIGHLY AS TESTS OR EXAMINATIONS.

IN ADDITION, THE COGNITIVE LEVEL OF PERFORMANCE EXPECTED BY FACULTY ON TESTS & QUIZZES WAS COMPARABLE TO THEIR COGNITIVE LEVEL OF DISCOURSE.

DO YOU HAVE ANY QUESTIONS ABOUT WHAT WE HAVE COVERED SO FAR?

BASED ON THIS INFORMATION, THEN, I WILL ASK YOU TO COMPLETE AN INSTRUMENT. WHAT I NEED YOU TO DO IS THINK ABOUT THOSE ACTIVITIES WHICH ARE A PART OF YOUR TEACHING, NAMELY THE TESTS, QUIZZES, ASSIGNMENTS AND IN-CLASS DISCOURSE (VERBAL INSTRUCTION). THEN, INDICATE IN THE SPACES THE PERCENTAGE OF YOUR TEACHING IN EACH AREA WHICH YOU **ASPIRE** TO OCCUR AT EACH OF THE LEVELS OF COGNITION. FOR EACH ACTIVITY, THE TOTAL MUST SUM TO 100%.

THIS LIST OF VOCABULARY MAY BE HELPFUL TO YOU IN THINKING ABOUT THE PERCENTAGES OF TEACHING YOU WISH TO OCCUR AT THE DIFFERENT LEVELS OF COGNITION.

REMEMBERING

PROCESSING

CREATING

EVALUATING

Appendix D

**Instrument to Collect Aspired Cognitive Level of
Instruction**

Code _____

Aspired Cognitive Level of Instruction

THIS QUESTIONNAIRE ENCOURAGES YOU TO DETERMINE THE COGNITIVE LEVEL AT WHICH YOU ASPIRE TO TEACH. PLEASE INDICATE IN THE SPACES PROVIDED, THE PERCENTAGE AT EACH LEVEL OF COGNITION AT WHICH YOU ASPIRE TO TEACH.

Using the handouts that were just reviewed, think about your tests, quizzes, assignments, and verbal instruction, then indicate in the spaces provided the percentage of your teaching which you aspire to occur at each of the levels of cognition. Each total must sum to 100%.

a. Tests

- 1. remembering _____
- 2. processing _____
- 3. creating _____
- 4. evaluating _____
- 5. total 100%

b. Quizzes

- 1. remembering _____
- 2. processing _____
- 3. creating _____
- 4. evaluating _____
- 5. total 100%

c. Assignments

- 1. remembering _____
- 2. processing _____
- 3. creating _____
- 4. evaluating _____
- 5. total 100%

d. Discourse

- 1. remembering _____
- 2. processing _____
- 3. creating _____
- 4. evaluating _____
- 5. total 100%

Thank you for your cooperation!

Appendix E

Instrument to Collect Attitude Toward Teaching at
Higher Cognitive Levels

**Professor's Attitude Toward
Teaching at Higher Cognitive Levels**

FOR EACH OF THE FOLLOWING ITEMS, PLEASE CIRCLE THE RESPONSE WHICH BEST REPRESENTS YOUR ATTITUDE TOWARD TEACHING AT HIGHER COGNITIVE LEVELS.

- 6 = strongly agree
5 = moderately agree
4 = slightly agree
3 = slightly disagree
2 = moderately disagree
1 = strongly disagree

	SA	MA	SA	SD	MD	SD
	6	5	4	3	2	1
1. It would take more time than it is worth to increase my cognitive level of teaching.	6	5	4	3	2	1
2. I enjoy opportunities for increasing my cognitive level of teaching.	6	5	4	3	2	1
3. I want to teach in a way that allows students to see higher level thinking exhibited.	6	5	4	3	2	1
4. I would like to know more about teaching at higher cognitive levels.	6	5	4	3	2	1
5. Teaching at the higher cognitive levels requires too much advanced preparation.	6	5	4	3	2	1
6. Professors need to encourage students to practice higher level thinking.	6	5	4	3	2	1
7. Students can get the knowledge they need from a college experience by memorizing.	6	5	4	3	2	1
8. 100 level courses cannot be taught at higher levels of cognition.	6	5	4	3	2	1
9. It is important for professors to assist students in developing higher level thinking skills.	6	5	4	3	2	1
10. Higher level teaching is critical to the permanent learning of students.	6	5	4	3	2	1

	SA	MA	SA	SD	MD	SD
	6	5	4	3	2	1
11. I am frustrated about teaching at higher cognitive levels.	6	5	4	3	2	1
12. I am excited about teaching at higher levels of cognition.	6	5	4	3	2	1
13. Quality of students at the undergraduate level allows for higher cognitive level teaching.	6	5	4	3	2	1
14. Professors present too much material at the evaluating level.	6	5	4	3	2	1
15. I want to teach at higher cognitive levels.	6	5	4	3	2	1
16. Professors' objectives should be written to challenge students at higher cognitive levels.	6	5	4	3	2	1
17. I am willing to devote more time, if needed, to grade assignments written at higher cognitive levels.	6	5	4	3	2	1
18. I intend to substantially revise my current cognitive level of teaching.	6	5	4	3	2	1
19. My subject matter does not lend itself to higher level teaching.	6	5	4	3	2	1
20. Professors encourage too much remembering.	6	5	4	3	2	1
21. The nature of lower level courses does not require higher cognitive level of teaching.	6	5	4	3	2	1
22. Students will operate at the cognitive level at which I expect them to operate.	6	5	4	3	2	1
23. Large classes do not lend themselves to methods which reflect higher cognitive level teaching.	6	5	4	3	2	1
24. Modeling higher level thinking in class will not influence students to think at higher cognitive levels.	6	5	4	3	2	1
25. Students are willing to do more than memorize.	6	5	4	3	2	1

	SA	MA	SA	SD	MD	SD
	6	5	4	3	2	1
26. It is the responsibility of the student to take information from class and use it at higher cognitive levels.	6	5	4	3	2	1
27. I am willing to spend more time on certain topics to teach them at higher cognitive levels.	6	5	4	3	2	1
28. It is important for students to be able to process information.	6	5	4	3	2	1
29. Students should be given more opportunities to exercise creativity.	6	5	4	3	2	1
30. Professors do not have the extra time needed to teach across the levels of cognition.	6	5	4	3	2	1
31. Students in my courses, generally are not mentally ready to be challenged at higher cognitive levels.	6	5	4	3	2	1
32. Any subject matter can be taught at higher cognitive levels.	6	5	4	3	2	1
33. Getting students to evaluate is an important goal of higher cognitive level teaching.	6	5	4	3	2	1
34. Students will develop more life-long learning skills if they are taught to create and evaluate.	6	5	4	3	2	1
35. I try to teach students to develop new ideas, products, or processes.	6	5	4	3	2	1
36. I want to teach across the levels of cognition.	6	5	4	3	2	1
37. Skills in evaluating will prove to be valuable to students.	6	5	4	3	2	1
38. I look forward to the challenge of narrowing the discrepancies between my desired and actual teaching scores.	6	5	4	3	2	1
39. Students in my course deserve to be challenged at higher cognitive levels.	6	5	4	3	2	1
40. I try to teach students to process the						

information that I present.	6	5	4	3	2	1
	SA	MA	SA	SD	MD	SD
	6	5	4	3	2	1
41. I receive recognition by my co-workers for accomplishing higher cognitive level teaching.	6	5	4	3	2	1
42. The cognitive level at which I teach is adequate.	6	5	4	3	2	1
43. I could teach at higher levels of cognition, but choose not to teach at higher levels of cognition.	6	5	4	3	2	1
44. As I teach at higher cognitive levels, I expect to see students operating at higher cognitive levels.	6	5	4	3	2	1
45. The higher the level of the course, the higher the cognitive level at which the course should be taught.	6	5	4	3	2	1
46. I try to teach students to evaluate.	6	5	4	3	2	1
47. I would need help in order to teach at higher levels of cognition.	6	5	4	3	2	1
48. I have to be patient to nurture higher level thinking among students.	6	5	4	3	2	1
49. Students complain too much when they are taught at higher levels of cognition.	6	5	4	3	2	1
50. I teach students to separate fact from opinion.	6	5	4	3	2	1

Thank you for your cooperation!

Appendix F**Inservice Topics and Formats Instrument**

Code _____

Suggestions for Inservice Education to Improve Cognitive Level of College Instruction

Recently, the quality of college and university teaching has been of increasing concern. Challenges presented to faculty members have included teaching students to think critically. To assist professors with developing necessary strategies and techniques to meet the challenge, inservice education may be needed. Your assistance is sought in identifying favorable topics and formats for inservice education.

Below is a list of possible inservice topics. Please rate the extent to which you favor each inservice education topic. Respond by circling the number that corresponds to the following statements:

- 5 = very favorable
- 4 = fairly favorable
- 3 = don't know
- 2 = fairly unfavorable
- 1 = very unfavorable

	VF	FF	DK	FU	VU
	5	4	3	2	1
1. An overview of cognitive levels of learning	5	4	3	2	1
2. Writing tests at higher levels of cognition.	5	4	3	2	1
3. Strategies to follow to teach at higher cognitive levels.	5	4	3	2	1
4. Designing assignments at higher levels of cognition.	5	4	3	2	1
5. Using higher levels of cognition in my own delivery of instruction.	5	4	3	2	1
6. A synthesis of research on cognitive levels of instruction.	5	4	3	2	1
7. Lectures that reach higher levels of cognition.	5	4	3	2	1
8. Grading to reward higher level thinking	5	4	3	2	1
9. Problem Solving teaching and higher order thinking.	5	4	3	2	1

Continued from page 1

	VF	FF	DK	FU	VU
	5	4	3	2	1
10. Implementing a departmental plan for teaching at higher cognitive levels.	5	4	3	2	1

Other topics of interest

Offering inservice education to faculty can be accomplished in various ways. Below is a list of possible formats. Please rank (1-6) the formats by placing a "1" in the space provided next to the format which most appeals to you and continue through each format until you place a "6" next to the format that least appeals to you.

Rank

- _____ self-paced modules
 - _____ faculty workshops
 - _____ intensive 1-week program
 - _____ one-on-one interaction
 - _____ consultation on "as requested" basis
 - _____ brown bag seminars across one quarter
 - _____ other suggested formats
-

Thank you for your cooperation!

Appendix G
Bloom's Taxonomy

DESCRIPTION OF BLOOM'S TAXONOMY

I. Knowledge Level

A. Consists of memorizing or identifying facts. It is a student's "file" of information that can be recalled or brought to mind later. It provides the basis for greater understanding (Chamberlain and Kelly, 1981).

B. The knowledge level itself ranges from specific, concrete facts, or information to more complex and abstract theory. The taxonomy level of knowledge is divided into the following sub-levels (Hunkins, 1972):

1. Knowledge of Specifics - the recall of specific, separate bits of information. This type of question provides the student with a data base.
 - a. Knowledge of terminology - definitions
 - b. Knowledge of specific facts - includes dates, events, persons, places, etc
2. Knowledge of Ways and Means of Dealing with Specifics - knowledge of the ways of organizing, studying, judging, and criticizing. Does not require the student to be able to understand or utilize the concept; only requires an

Knowledge Level (continued)

awareness of the concept.

- a. Knowledge of conventions - awareness of accepted ways of dealing with types of information or situations. Example: "What is the correct form for a business letter?"
- b. Knowledge of trends and sequences - questions student's knowledge of various phenomena in relation to the dimension of time. The emphasis is not on student understanding of the trend, but only that they recognize it exists. Example: "What were the events that led up to World War II?"
- c. Knowledge of classifications and categories - emphasis is placed upon the students remembering certain groupings of information. They are not required to do anything with the categories; they are only asked to recall from memory certain classifications. Example: "What are the four basic food groups, and which foods are contained in each?"
- d. Knowledge of criteria - emphasis is on awareness of criteria developed. Identification or listing of criteria is requested; not an understanding of the basis for

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

- e. Knowledge of methodology - this dimension is only concerned with the student's awareness of several methods or processes, not his ability to apply them to actual situations. Example: "If a teacher wishes to individualize instruction, the first step should be to:
- (1) Select materials.
 - (2) Consider his/her own competencies.
 - (3) Diagnose the abilities, needs, and interests of the students in class.
 - (4) Get permission from the principal.
- f. Knowledge of the Universals and Abstractions in a Field - deals with knowledge of principles and generalizations and knowledge of theories and structures. Questions at this level are asking only for an awareness of various abstractions. Example: "What is the basic structure of the discipline of economics, as presented in class?"

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

1. Translation - focuses on the student's ability to translate or paraphrase information from one to another. Knowledge is required, but the emphasis is on using this knowledge to understand material. Translation could involve:
 - a. repeating what the author said, using the learner's own words.
 - b. translation of a foreign language into English.
 - c. translation of material from technical terms into layman's terms.
2. Interpretation - the emphasis is on grasping the basic ideas or general meaning of the material.
 - a. The learner must be able to translate each major part of the material so that it becomes meaningful.
 - b. The learner must then rearrange or reorder the material to determine significant and non-significant portions.

- c. The learner must finally be able to relate the information (fact, generalization, definition, skill, etc.) to new situations.
3. Extrapolation - extends the ability to translate and interpret by student's expanding the information to determine implications, consequences, effects, etc., based on the original communication.

III. APPLICATION

- A. Education should be preparation for life.
Application questions are designed to give students practice in the transfer of training; applying what has been learned to other situations and learning tasks.
- B. There are three main characteristics of questions in the application category (Sanders, 1966).
 1. They deal with knowledge which has explanatory or problem-solving power - the kind of knowledge transferable to many situations.
 2. They deal with whole ideas and skills, rather than solely with parts.
 3. They include a minimum of directions or instructions; part of the challenge lies in the student being able to determine the

appropriate problem-solving process to use.

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

V. ANALYSIS

- A. Analysis may be regarded as a further step in the "comprehension" of an idea, product, or document. It requires the student to "see" the underlying ideas, devices, and workings of a document or communication (Bloom et al., 1981).
- B. While analysis is slower and more difficult than the comprehension process, it is very important to use where deeper understanding is required before decisions are reached and problems are attacked (Bloom et al., 1981).
- C. It is likely that once analytical abilities are developed in a number of fields of knowledge, they can be applied to new problems in a creative way (Bloom et al., 1981).
- D. Analyzing includes: (1) separating relevant material from trivia; (2) distinguishing facts from hypotheses; and (3) differentiating between objective data and value judgement (Chamberlain and

Kelly, 1981).

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

1. Analysis of Elements - the student is expected to break down the material into its constituent parts, then identify and classify those parts.
2. Analysis of Relationships - differentiate between various relationships among the elements and determine their connection and inter-action.
3. Analysis of Organizational Principles - the student is able to determine the author's purpose, point of view, attitude, or general conception of a field, in order to better comprehend the meaning of the material.

V. SYNTHESIS

- A. Synthesis questions encourage students to think creatively and make original conclusions. It is the ability to put parts and elements together in a form new to the student (Chamberlain and Kelly, 1981).
- B. This is the category in the cognitive domain which most clearly provides for creative behavior on the part of the learner; this work is still expected to be within the limits set by particular problem

theories or method.

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

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

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

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

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

1. Strengths of Synthesis Questions

- a. Allows students great freedom in seeking solutions.

- b. The question has many possible approaches to

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

- c. The solution requires a product.

2. Weaknesses of Synthesis Questions

- a. Asks questions that call for mental creativity, but often may have no correlation with course objectives.
- b. There is the possibility of forming questions that are totally beyond the competence of the student.
- c. It is difficult to evaluate the answers fairly.
- d. It is often difficult to provide conditions favorable for creative work.

VI. EVALUATION

- A. Evaluation questions are those requiring the student to make a judgement about something, using some criteria or standard for making the judgement (Clegg, 1967).
- B. Bloom makes the point that evaluation is not an activity done after all the other levels of intellectual skills have been used. To some degree, evaluation can be considered a "floating"

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

- C. Unfortunately, too often only the knowledge level in the cognitive domain is emphasized and evaluated. Students are taught facts and specifics and are then asked to repeat them in various ways (Chamberlain and Kelly, 1981).
- D. Bloom and others (1956) have divided the evaluation level into two sub-levels.
 - 1. Evaluation in Terms of Internal Evidence - requires the student to analyze data or conclusions from standpoints such as logical accuracy, consistency, and other internal criteria.
 - 2. Evaluation in Terms of External Criteria - focus is on having students apply known criteria to judge various situations or conditions that he encounters or develops.

Source: Newcomb and Trefz (1987). Unpublished manuscript.
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Appendix H

Levels of Cognition Described
Newcomb-Trefz Model

COGNITIVE LEVELS OF LEARNING

A. Remembering

1. Involves the ability to memorize and recall:
 - a. simple, concrete facts, definitions, dates, etc.
 - b. means of classifying or categorizing these facts
 - c. complex, abstract theories or generalizations
2. No understanding of the concepts or principles of the information is required.

B. Processing

1. Involves the use of known facts, principles, theories, etc.
2. Uses included in this level are:
 - a. comprehension of the meaning and intent of the material
 - b. application of understood information to new and unique situations
 - c. analysis of the information or situation to increase understanding and facilitate problem solving

C. Creating

219

1. Involves the ability to combine pieces of information in a form that is new to the student.
2. Provides the opportunity for independent thinking; self expression.
3. Generally involves the development of some type of product:
 - a. a communication that expresses the unique ideas, feelings, and experiences of the student.
 - b. a plan or solution to a particular situation.
4. This product can be used to inform, describe, persuade, impress, or entertain.

D. Evaluating

1. Involves the ability to make a judgment or critical evaluation, for a given set of information, that is based on a standard or specific criteria.
2. The judgment/evaluation can be based on:
 - a. internal evidence - assessing the accuracy, consistency, and logic of the material.
 - b. external criteria - applying established criteria to judge or evaluate a particular situation or document.
3. The criteria used in the evaluation can be either from established standards or those determined by the student.

CHARACTERISTICS AND EXAMPLES OF QUESTIONS
AT THE LEVELS OF LEARNING

REMEMBERING

A. Characteristics of the Level

1. The student would be able to offer the answer out of his/her memory; he/she is not required to understand, compare, relate, or make any independent reasoning in providing the answer.
2. A question at this level is worded in a way identical to the way the information was originally learned. Items should not use terms which are new to the student.
3. Any question, regardless of its presumed complexity, which can be answered through mere recall of information previously discussed in class or in the text should be categorized as a knowledge level question.

B. Representative Question Types and Sample Questions

1. Completion item
 - a. Example - The preferred inventory valuation method for corn in storage on a cash grain farm is _____.
2. Request for a definition, statement of principle, method, or steps of a model.

- a. Example - List the steps in pork slaughter from stunning through hanging of the carcass.
- 3. Choice questions (such as multiple choice, true/false, matching), where the student selects from a set of given alternatives.
 - a. Example - A firm's ability to pay all obligations if assets were liquidated is measure by: (1) liquidity; (2) solvency; (3) profitability; (4) financial efficiency and activity

PROCESSING

A. Characteristics of the Level

Students must be able to:

- 1. translate ideas or concepts into their own words or in form useful to them in solving the problem;
- 2. select an approach (out of several possibilities) to solve a problem or situation that is new to the student;
- 3. identify, classify, discriminate, or relate particular qualities or characteristics of the material.

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

B. Representative Question Types and Sample Questions

1. Predict what will happen in new situations using appropriate principles or criteria.
 - a. Example - If a 6-inch pulley on the output shaft of the motor drives a 3.5-inch pulley on the input shaft of the pump through a V-belt drive and the motor is turning at 1725 rpm, what is the torque (ft. lbs.) on the input shaft of the pump?
2. Select an approach (from several reasonable possibilities) to deal with a problem or explain a concept.
 - a. Example - Which method of cooking would be most desirable for a muscle region in which fibrous connective tissue content was high? (a) roasting; (b) broiling; (c) braising; (d) frying
3. Use established criteria (such as cause/effect or sequence) to classify the content of materials or distinguish a pattern, order, or arrangement.
 - a. Example - Which of the following processing procedures could lead to trouble when making a batter-type sausage item? (a) add the salt early in the chopping procedure; (b) add regular pork trimmings first, leaving boneless bull beef for the last 1/3 of the chopping procedure; (c) add ice water so as to have 10% more moisture in the finished product that was determined by the normal moisture to protein ration; (d) cook to an

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

CREATING

A. Characteristics of the Level

1. The student may identify the task or problem for him/herself, or at least have freedom in interpreting it.
2. The student may have the option to attack the problem with a variety of references or other materials. Problems at the creating level are often used in open-book examinations.
3. The problem, task, or situation involving creating should be new or in some way different from those used in the instruction.

B. Representative Question Types and Sample Questions

1. The ability to ask the right questions when faced with a problem situation.
 - a. Example - You have two dwarf apple trees which were planted at the same time and were acquired from the same grower. The trees are now seven years old. One tree has flowered and set fruit regularly; the other tree has yet to flower. Identify questions which would need to be pursued in attempting to design a problem solution.
2. Plan an appropriate course of action to a given

situation.

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

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

Additional information well known to fishermen, little boys, and earthworms: (1) earthworms come to surface of soil during a heavy rain; (2) earthworms go underground if bright light is

shown on them; (3) earthworms come to surface if electric current is introduced into wet soil.

EVALUATING

A. Characteristics of the Level

1. Make judgments about the worth or value of an idea, solution, method, etc. using a set of criteria as a basis for the judgment.
2. The problem situation or material to be evaluated should be available to the students as they make the evaluation, and they should be able to refer to it as they attempt to answer the evaluative questions or problems.

B. Representative Question Types and Sample Questions

1. Recognize the extent to which particular details of a document are accurate, precise, or carefully done.
 - a. Example - From the enclosed sample pages from a farm record book, note any errors, any incomplete information, and analyze in terms of the appropriateness and completeness of the information.
2. Recognize the ways in which the parts of a work fit together in terms of consistency, order, and organization.
 - a. Example - Analyze the attached landscape to plan for a front entrance and suggest modifications

needed, if any.

3. Identify the criteria on which a judgement has been based for a particular situation.
 - a. Example - The animals shown in the slide provided have been placed in carcass evaluation in the following order. Compare the slide of the live animals and the carcass slide and list those characteristics you feel were considered in making this decision. Which characteristics were particularly relevant in making this placing?
4. Analyze and evaluate a new situation or set of information by relating it to another situation that was previously studied in the course.
 - a. Example - Based on what was studied in class for determining feed rations for a cattle herd, what suggestions would you make to the herdsman in terms of the following ration for the following herd specification? (Specifics of ration and herd would be included here.)
5. Establish his/her own criteria to judge a particular situation.
 - a. Example - Develop a decision making model for determining the efficacy of using bio-technology procedures to increase milk production.

Appendix I

Florida Taxonomy of Cognitive Behavior

1 2 3 4 5 6 7 8 9 10

1. Knowledge of specifics

- ☐ 1. Reads
- ☐ 2. Spells
- ☐ 3. Identifies something by name
- ☐ 4. Defines meaning of term
- ☐ 5. Gives a specific fact
- ☐ 6. Tells about an event

1.2 Knowledge of ways and means of dealing with specifics

- ☐ 7. Recognizes symbol
- ☐ 8. Cites a rule
- ☐ 9. Gives chronological sequence
- ☐ 10. Gives steps of process, describes method
- ☐ 11. Cites trend
- ☐ 12. Names classification system or standard
- ☐ 13. Names what fits given system or standard

1.3 Knowledge of universals and abstracts

- ☐ 14. States generalized concept or idea
- ☐ 15. States a principle, law, theory
- ☐ 16. Tells about organization or structure
- ☐ 17. Recalls name of principle, law, theory

2.0 Translation

- ☐ 18. Restate in own words or briefer terms
- ☐ 19. Gives concrete examples of an abstract idea
- ☐ 20. Verbalizes from a graphic representation
- ☐ 21. Translates verbalization into graphic form
- ☐ 22. Translates figurative statements into literal statements or vice versa
- ☐ 23. Translates foreign language to English or vice versa

3.0 Interpretation

- ☐ 24. Gives reason (tells why)
- ☐ 25. Shows similarities differences
- ☐ 26. Summarizes or concludes from observation of evidence
- ☐ 27. Shows cause and effect relationship
- ☐ 28. Gives analogy, simile, metaphor
- ☐ 29. Performs a directed task or process

1 2 3 4 5 6 7 8 9 10

4.0 Application

- 30. Applies previous learning to new situations
31. Applies principle to new situation
32. Applies abstract knowledge in a practical situation
33. Identifies, selects and carries out process

5.0 Analysis

- 34. Distinguishes fact from opinion
35. Distinguishes fact from hypothesis
36. Distinguishes conclusion from statements which support it
37. Points out unstated assumption
38. Shows interaction or relation of elements
39. Points out particulars to justify conclusions
40. Checks hypotheses with given information
41. Distinguishes relevant from irrelevant statements
42. Detects error in thinking
43. Infers purpose, point of view, thoughts, feelings
44. Recognizes bias or propaganda

6.0 Synthesis (Creativity)

- 45. Reorganizes ideas, materials, processes
46. Produces unique communication, divergent idea
47. Produces a plan, proposed set of operations
48. Designs an apparatus
49. Designs a structure
50. Devises a scheme for classifying information
51. Formulates hypotheses, intelligent guesses
52. Makes deductions from abstract symbols, propositions
53. Draws inductive generalization from specifics

7.0 Evaluation

- 54. Evaluates something from evidence
55. Evaluates something from criteria

Appendix J
Observation Form

			Class _____
			Instructor _____
			Date/Time _____
<u>Interval</u> <u>(min.)</u>	<u>Time</u>	<u>Counter</u> <u>#</u>	<u>Description of Class</u>
:00	_____	000	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____
:06	_____	061	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____
:12	_____	127	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____
:18	_____	202	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____
:24	_____	287	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____
:30	_____	392	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____
:36	_____	472	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____
:42	_____	537	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____
:48	_____	608	Begins with _____
			Classroom Interaction _____
			Teaching Aids Used _____

Appendix K
Approximate Time Commitment

**Approximations of Time Commitment
Per Professor**

Task	Time
Collect demographics with interview	:30
Review levels of cognition	:30
Determine aspired level of teaching	:30
Computer input	:15
FTCB	3:00
Record FTCB	6:00
Computer input	:45 (15+15+15)
Assess midterm	1:00
Assess final	2:00
Assess quiz	:30
Assess assignments	:15
Meet with professors for consensus	1:00
Review aspired/assessed	:30
Collect attitude/needs	1:00
computer input	1:00 (30 +30)
Total Approximate Time	20:00

Appendix L
Raw Data Recording Form

Raw Data

Name _____ Code _____

	R	P	C	E	Total
FTCB#1					
FTCB#2					
FTCB#3					
Total					
%					
HW 1					
HW 2					
HW 3					
Total					
%					
MT #1					
MT #2					
Final					
Total					
%					

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